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The Engineer.

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VOL. CXXXIV.—No. 3472] LONDON: FRIDAY EVENING, JULY 14, 1922 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

The Royal Agricultural Show—No. II.

Chinese Engineering Notes.

Institution of Naval Architects: Summer Meeting in France.

The Chalk Farm Widening—L. & N.W. Rly.

The Heat Pump.

Short Histories of Famous Firms—No. XIII.

The Society of Chemical Industry.

Six Months' Fluctuations in the Prices of Fuel and Materials.

The Gennevilliers Power Station.

Testing Shipbuilding Materials.

PUBLIC NOTICES

ASSISTANT LOCOMOTIVE SUPERINTENDENTS, INDIAN STATE RAILWAYS.

The Secretary of State for India will, in 1922, with the advice of a Selection Committee, make FOUR APPOINTMENTS as ASSISTANT LOCOMOTIVE SUPERINTENDENTS for service on Indian State Railways, if so many suitable candidates present themselves.

Candidates must be British subjects, not more than 26 years of age, and must be of good moral character and sound physique. They must have had a good general and technical education, followed by at least three years' training in the locomotive workshops of a British railway company or a locomotive builder of repute, and should have had six months' training in the running sheds and firing. A knowledge of applied mechanics and composition of all materials used in shops is essential, and applicants should be able to design and to calculate the stresses on the parts of the machines. Some drawing-office experience is also desirable.

Persons whose practical experience falls short of three years, but who have served in His Majesty's Forces during the war, will be eligible as candidates; but, if selected, will be required before appointment to complete satisfactorily such further period of training as the Secretary of State may prescribe.

Candidates may be required to appear before a Selection Committee at the India Office. They will also be required to pass a medical examination if selected for appointment.

The regulations in respect of the appointments and forms of application for use by candidates can be obtained on application to the SECRETARY, Public Works Department, India Office, Whitehall, London, S.W. 1. Applications for appointment must reach the India Office not later than 31st July, 1922.

India Office,
16th June, 1922. 8525

Assistant Engineer Required by the GOVERNMENT of NIGERIA for the Port Harcourt Wharfage Works, for a tour of 12 to 18 months' service, with possible extension. Salary £600 a year, rising to £720 a year by annual increments of £30. Outfit allowance of £60 paid on first appointment. Free single quarters and passages. Liberal leave in England on full salary. Candidates, age between 25 and 35, must be duly qualified civil engineers and have had a wide experience on an engineer's or contractor's staff in the actual construction of reinforced concrete work, structural steel work (jetties and sheds).—Apply at once, in writing, giving age and brief details of experience, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/Nigeria 11,327.
It is useless for candidates without the experience and qualifications indicated to apply. 8761

Assistant Engineer Required by the GOVERNMENT of JAMAICA for Railway Construction. Salary £500 a year and £100 a year field allowance. Free passages. Period of engagement 18 months. Candidates, age not over 38, must be single, well educated and experienced in the location and construction of railways, in the preparation of quantities, specifications and contracts, also in the construction of bridge work, masonry, &c., and possess a good practical knowledge of the laying out of station yards and erection of railway station buildings.—Apply at once, in writing, giving age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Jamaica 11,487. 8823

The South Wales Institute of ENGINEERS.

INSTITUTE ENGINEERING EXHIBITION.

DRILL HALL, CARDIFF,

NOVEMBER 20TH–25TH (Inclusive).

SCHEDULE OF PROPOSED EXHIBITS.

SECTION 1.

Scientific, Measuring and Recording Instruments, as applied to all branches of Engineering.

SECTION 2.—STEAM SECTION.

Water Softening and Cooling Plant.
Boilers and Equipment.
Oil Burners.
Pipes, Valves, Separators, &c.
Drawings of Models of Modern Engines.
Governors and Safety Devices.

SECTION 3.—ELECTRICAL SECTION.

Switchgear, Cables, Controllers, &c.
Electrical Tools and other Appliances.
Overhead Lines.
Small Motors.
Electric Cranes.
Telephones and Wireless Apparatus.

SECTION 4.—MECHANICAL SECTION.

Mechanical Transmission of Power.
Bearings, Clutches, Ropes, Belts, Gearing, &c.

SECTION 5.—WORKSHOP APPLIANCES.

Machine Tools (small).
Pneumatic Tools.
Hydraulic Tools.

SECTION 6.—MINING AND GENERAL.

Shaft Signalling.
Devices to Prevent Overwinding.
Models of Pit Cages and Tram Tipplers.
Steel Castings (limited in size and weight).
Models of Coke Ovens, By-product and Recovery Plant.
Coal Cutting and Conveying Machines.
Pumping Plant.
Models of Screening Plant.

As far as practicable, exhibits will be arranged in their various Sections, but exhibitors will be allowed, when exhibiting under more than one Section, to group their exhibits on one stand.

The Exhibition will be opened each day at 2 p.m. and remain open until 8 p.m.

In connection with the Exhibition a Conference will be held each morning at the Institution, Park-place, Cardiff, at which papers on engineering subjects will be read and discussed.

Last date for receiving applications for space is July 31st.

Entry forms, ground plan of Exhibition and full particulars may be had on application to the SECRETARY, The South Wales Institute of Engineers, Park-place, Cardiff. 8769

Leeds University.

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING.

The University Council will shortly proceed to the APPOINTMENT of a DEMONSTRATOR in MECHANICAL ENGINEERING. Works experience in addition to good academic qualifications essential. Salary £250.—Further particulars may be obtained from the REGISTRAR, The University, Leeds, by whom applications will be received up to the 24th July. 8722

PUBLIC NOTICES

University of Liverpool.

FACULTY OF ENGINEERING.

DEAN: Professor T. B. ABELL, O.B.E., M. Eng., R.C.N.C. (Ret.), M. Inst. N.A.

PROFESSORS AND LECTURERS.

ENGINEERING.
Harrison Professor—W. H. WATKINSON, M. Eng., M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Robert Rankin Professor of Engineering (Thermodynamics of Heat Engines)—G. E. SCHOLES, M.B.E., M.Sc., A.M.I.A.E.
John William Hughes Professor of Engineering (Strength of Materials)—W. MASON, D.Sc., M. Inst. C.E., A.M.I. Mech. E.
MARINE ENGINEERING.
Professors and Lecturers in Naval Architecture and Engineering.
ELECTRICAL ENGINEERING.
David Jardine Professor—E. W. MARCHANT, D.Sc., M.I.E.E.
Lecturer in Electrical Machinery—F. J. TEAGO, M.Sc., M.I.E.E.
Lecturer in Municipal Electrical Engineering—Vacant.
CIVIL ENGINEERING.
Professor S. W. PERROTT, M.A.I., M. Inst. C.E.
Lecturer in Railway Engineering—Associate Professor Sir J. A. F. ASPINALL, M. Eng., M. Inst. C.E., M.I. Mech. E., M.I. and S.I.
Lecturer in Municipal Engineering—Associate Professor J. A. BRODIE, M. Eng., F. Inst. C.E., M.I. Mech. E.
Lecturer in Dock and Harbour Engineering—Associate Professor T. R. WILTON, M.A., M. Inst. C.E., M. Cons. E.
NAVAL ARCHITECTURE.
Alexander Elder Professor—T. B. ABELL, O.B.E., M. Eng., R.C.N.C. (Ret.), M. Inst. N.A.
ENGINEERING DESIGN AND DRAWING.
Professor J. WEMYSS ANDERSON, M. Eng., M. Inst. C.E., M.I. Mech. E.
REFRIGERATION.
John William Hughes Professor of Engineering—J. WEMYSS ANDERSON, M. Eng., M. Inst. C.E., M.I. Mech. E.
METALLURGY.
Henry Bell Wortley Professor—C. O. BANNISTER, Assoc. R.S.M., F.I.C.
MATHEMATICS.
Professor F. S. CAREY, M.A.
APPLIED MATHEMATICS.
Professor J. PROUDMAN, M.A., D.Sc.
MATHEMATICAL HYDROGRAPHY.
Lecturer—R. O. STREET, M.A., M.Sc.
PHYSICS.
Lyon Jones Professor—L. R. WILBERFORCE, M.A.
Senior Lecturer—J. RICE, M.A.
CHEMISTRY.
Grant Professor of Inorganic Chemistry—E. C. C. BALY, C.B.E., M.Sc., F.R.S.
Senior Lecturer in Analytical Chemistry—J. SMEATH THOMAS, D.Sc.
GEOLOGY.
George Herdman Professor—P. G. H. BOSWELL, O.B.E., D.Sc., M. Inst. M.M., F.G.S.

The Prospectus of the Faculty may be obtained on application to the undersigned.

EDWARD CAREY,
Registrar.
8712

The National Foremen's Association of the ENGINEERING AND ALLIED TRADES.

(Registered under the Trade Union Act.)

An Association specifically formed to look after the interests of Foremen in their Supervisory Capacity.

All communications to Head Offices,
H. W. REID, 95, Belgrave-road,
General Secretary, Victoria, S.W.1
Ex.

PUBLIC NOTICES

The British Cast Iron Research ASSOCIATION.

APPOINTMENT OF DIRECTOR OF RESEARCH.

The Council invite APPLICATIONS for the POST of DIRECTOR of RESEARCH to the Association at a commencing salary not exceeding £900 per annum, according to scientific attainments and foundry, blast-furnace or other suitable industrial experience.

Forms of application can be obtained from the undersigned, which are to be returned on or before August 31st, 1922.

THOS. VICKERS,
Secretary.
Central House,
New-street, Birmingham,
July 5th, 1922. 8752

Bombay, Baroda, and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Wednesday, 2nd August, TENDERS for the SUPPLY of—

1. METALS.
2. BOLTS, NUTS and RIVETS.
3. DOG SPIKES.
4. WIRE GAUZE and NETTING.
5. WOOD SCREWS, NAILS, SPLIT PINS, &c.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each for Nos. 1 and 2 and 10s. each for Nos. 3, 4 and 5 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

(Sgd.) S. G. S. YOUNG,
Secretary.
Offices: The White Mansion,
91, Petty France,
Westminster, S.W. 1,
10.7.22. 8779

London County Council.

TENDERS are INVITED for the PURCHASE and REMOVAL of the undermentioned PLANT:—

SIX WATER-TUBE BOILERS of the Stirling five-drum type, each fitted with superheated and two chain grate stokers. Each boiler has a rated output of about 14,000 lb. of water evaporated an hour from and at 212° F.

THREE GREEN'S ECONOMISERS, each fitted with scraper gear and having a heating surface of 3200 square feet.

The plant may be inspected at the Council's Tramway Power Station, Hoskins-street, East Greenwich, between the hours of 9 a.m. and 5 p.m. on any weekday, except Saturday, from 17th to 31st July, 1922, both dates inclusive, upon production of the Tender form.

Particulars and forms of Tender may be obtained on application personally or by letter to the General Manager, London County Council Tramways, 23, Belvedere-road, Lambeth, S.E. 1.

Tenders must be addressed to the Clerk of the Council and delivered at the County Hall, Westminster Bridge, S.E. 1, not later than Twelve Noon on Tuesday, 1st August, 1922. No Tender received after that time will be considered.

The Council does not bind itself to accept the highest or any Tender.

JAMES BIRD,
8500 Clerk of the London County Council.

PUBLIC NOTICES

Borough of Camberwell.

TO ENGINEERS, BOILERMAKERS, &c.

The Council invite TENDERS for ONE NEW WATER-TUBE STEAM BOILER and TWO NEW HORIZONTAL STEAM CALORIFIERS in connection with the re-arrangement of the Boiler-house at the Public Baths, Church-street, Camberwell, S.E. 5.

Specification and form of Tender can be obtained from Mr. Frederick J. Slater, Borough Engineer, Town Hall, Camberwell, S.E. 5.

Tenders, together with complete drawings and full particulars, must be delivered on or before Wednesday, 26th July, 1922, not later than 5 p.m.

C. WILLIAM TAGG,
8790 Town Clerk.

Rohilkund and Kumaon Railway COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

(A) 100 COVERED GOODS WAGONS.
(B) 300 PAIRS of WHEELS and AXLES,

as per specifications to be seen at the Company's offices.

Tenders, addressed to the undersigned and marked "Tender for Goods Wagons," or as the case may be, are to be lodged not later than Noon on Friday, the 4th day of August, 1922.

For each specification a fee of 10s. will be charged, which cannot under any circumstances be returned.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
E. A. NEVILLE,
Secretary.
237, Gresham House,
Old Broad-street, London, E.C. 2,
5th July, 1922. 8765

State Electricity Commission OF VICTORIA.

TENDERS FOR PLANT.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.

Copies of Tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 261.—STRAIN and PIN TYPE INSULATORS.

CHARGE.—42 2s. for the first three copies of Tender form, conditions of contract, specification and drawing complete. These charges will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than Noon, 16th September, 1922.

R. LIDDELOW,
Secretary.
8589 State Electricity Commission of Victoria, Melbourne, Victoria, Australia.

The Assam-Bengal Railway COMPANY, Limited, is prepared to receive TENDERS for:—

(1) 25 BOGIE RAIL and TIMBER TRUCKS.
(2) 100 PAIRS of WHEELS and AXLES.

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2. A fee of £1 1s. is charged for each specification, which cannot under any circumstances be returned.

Drawings may be had at the cost of the tenderer by application to Messrs. Hodges, Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Friday, the 28th July, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
OSWALD I. MILNE,
Secretary.
7th July, 1922. 8766

The South Indian Railway COMPANY, Limited, are prepared to receive TENDERS for the SUPPLY of:—

SCREWS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Screws," must be left with the undersigned not later than Twelve Noon on Friday, the 28th July, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the specification.

Copies of the drawings may be obtained at the office of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France, S.W. 1,
13th July, 1922. 8793

PUBLIC NOTICES (continued) Page 2.

SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PATENTS, Page 4.
MACHINERY, &c., WANTED, Page 4.
FOR SALE, Pages 4 and 8.
AUCTIONS, Pages 3 and 100.
PREMISES TO LET OR WANTED, Page 3.
WORK WANTED, Page 8.
AGENCIES, Page 2.
MISCELLANEOUS, Page 3.

For Advertisement Rates See Page 41, Col. 1.

NUMERICAL INDEX TO ADVERTISEMENTS Page 99.

PUBLIC NOTICES

The South Indian Railway Company.

PANY, Limited, are prepared to receive TENDERS for the SUPPLY of :—

1. ROLLING STOCK (270 Steel Ballast Wagons and 9 Brake Vans).
2. STEEL TYRES (363 Locomotive and 2000 Carriage and Wagon).

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Rolling Stock," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 4th August, 1922.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of Specifications Nos. 1 and 2.

Copies of the drawings may be obtained at the office of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
13th July, 1922. 8794

West Ham Union.

TO LAUNDRY ENGINEERS.

The Guardians purpose having carried out certain alterations, involving the SUPPLY of NEW MACHINERY, the REMOVAL and RE-FIXING of existing MACHINERY, and the necessary SERVICES and SHAFTING, to MAIN LAUNDRY at their Central Home, Union-road, Leytonstone, E. 11, at an approximate cost of £5000.

Persons and firms desirous of tendering for the work should forward to the undersigned their names and addresses, together with a deposit of £2 2s., which will be returned upon receipt of a bona fide Tender. A copy of the drawing and specification prepared by the Architect of the Guardians, Mr. F. J. Sturdy, of 115, Moorgate, E.C. 2, will be sent in exchange.

Tenders must be delivered to the undersigned not later than 10 a.m. on Thursday, the 27th July, 1922.

By Order of the Board,
THOMAS SMITH,
Clerk to the Guardians.

Board Room, Union-road,
Leytonstone, E. 11,
10th July, 1922. 8791

Burma Railways.

TWO ASSISTANT LOCOMOTIVE SUPERINTENDENTS.

The Directors are prepared to receive APPLICATIONS (by letter only) from duly qualified candidates for APPOINTMENT as ASSISTANT SUPERINTENDENTS in the LOCOMOTIVE DEPARTMENT of the COMPANY in BURMA.

Candidates should not be more than 28 years of age (unmarried men preferred) and must have had a sound general education and have gone through a full course at a recognised Engineering and Technical College. They must have received a thorough training as locomotive and mechanical engineers, which should include running shed and main line driving experience, preferably on a British railway. Other things being equal, preference will be given to those who have some knowledge of electric lighting and power as applied to railway workshop plant.

SALARY.—To commence with Rs. 550 to Rs. 600 per calendar month, according to age, experience, and war service, rising in accordance with the Company's Rules.

Men who have been wounded in the war will be acceptable provided they are fit for their work.

TERMS.—Three years' agreement in the first instance, first-class free passage to Burma, and home again on satisfactory termination of engagement.

Selected candidates will be required to pass a strict medical examination before final appointment.

Letters of application, giving the candidate's age, whether married or single, details of general and technical education, training and subsequent career (in chronological order, with dates), accompanied by copies only of testimonials, service certificates, &c., should be addressed to the MANAGING DIRECTOR, Burma Railways Co., Ltd., 109, Gresham House, Old Broad-street, London, E.C. 2. 8786

Great Indian Peninsula Railway.

The Directors are prepared to receive written APPLICATIONS from duly qualified candidates for the APPOINTMENT of ASSISTANT MECHANICAL DRAUGHTSMAN in the Locomotive Department on the Company's staff in India.

The commencing salary will be Rs. 500 per month for the first year, Rs. 550 per month for the second year, and Rs. 600 per month for the third year of approved service, with prospect of rising ultimately to a maximum of Rs. 1100 per month.

Candidates, who must be unmarried and about 25 to 30 years of age, must have received a good general and technical education, and have served an apprenticeship or pupilage in the locomotive works of a British railway company or a locomotive manufacturer, and must be fully qualified draughtsmen with considerable experience in locomotive drawing-office work and in designing and estimating for locomotive workshop plants.

The appointment is for three years under agreement in the first instance, which may be subsequently extended by arrangement. The Company will provide a first-class passage to India, salary commencing on the date of sailing.

Applicants must give a full chronological record with dates of their general and technical education, practical engineering training and subsequent experience. They must state their age, and that they are unmarried. Those who served in the war should give particulars and dates of their Army service.

Applications, accompanied by copies of testimonials, must be addressed to the Company's Consulting Engineers, Messrs. ROBERT WHITE and PARTNERS, 3, Victoria-street, Westminster, S.W. 1. 8801

11th July, 1922.

Hull Corporation.

ELECTRICITY DEPARTMENT.

APPLICATIONS are INVITED for the undermentioned POSITIONS, namely :—

(A) COMBUSTION ENGINEER.
(B) PERSONAL TECHNICAL ASSISTANT.

(A) Candidates must be thoroughly experienced in the economical operation of modern large water-tube boilers, mechanical stokers and the sundry measuring instruments requisite in connection therewith; they must, in addition, have a sound theoretical knowledge of the chemistry of combustion.

(B) Candidates must have had a sound practical and theoretical engineering training and must be capable of carrying out accurate estimates in connection with both the extension and general operation of the department.

Salaries in both cases in accordance with N.J.B. Schedule, Class F, Grade 4.

Applications, stating age, full details of training, qualifications and general experience, together with copies of at least three recent testimonials, to be received by the undersigned not later than Noon, Thursday, July 20th.

H. BELL,
City Electrical Engineer.

Electricity Offices,
Sculcoates, Hull. 8783

SITUATIONS OPEN

WANTED, an Experienced ROPEWAY ENGINEER, capable of laying out plants on all systems and with full experience of design and detail of all parts.—Address applications, giving experience and salary, 8610, The Engineer Office. 8610 A

WANTED Shortly, an Experienced MAN for the North of England, with commercial knowledge of the import of iron ore and semi-manufactured goods as blooms and billets. Applicants should state age, experience, present employment, which will be treated in all confidence, and remuneration desired.—Address, 8767, The Engineer Office. 8767 A

PUBLIC NOTICE

SOUTH AFRICAN RAILWAYS AND HARBOURS.

ELECTRIFICATION OF GLENCOE-PIETERMARITZBURG SECTION.

TENDERS are INVITED for the SUPPLY and ERECTION in South Africa of the following PLANT in connection with the Electrification of the above Railways as follows :—

TENDER D. 1417.—COAL HANDLING PLANT for Power Station.
TENDER D. 1418.—ASH HANDLING PLANT for Power Station.
TENDER D. 1430.—CIRCULATING WATER SCREENING PLANT for Power Station.

Separate specifications and blue prints and forms of Tender for each of the above sections may be obtained at :—The Office of the High Commissioner for the Union of South Africa, Trafalgar-square, London, W.C. 2, and the Office of the Chief Railway Storekeeper, Park Station Chambers, Johannesburg, on and after Friday, the 28th July, 1922.

The Consulting Engineers, to whom application for any further technical information may be made, are Messrs. Merz and McLellan, 32, Victoria-street, London, S.W. 1.

Contractors may tender for all or any of the above sections.

The charge for each specification is Five Guineas for the first copy and Two Guineas each for any further copies. Sums paid for any number of each specification up to three will be refunded on receipt of bona fide Tenders.

Sums paid for copies of specifications beyond three of each will not be refunded.

Sealed Tenders, marked "Tender No. D. 1417" (or as the case may be), are to be addressed to The SECRETARY, Office of the High Commissioner for the Union of South Africa, Trafalgar-square, London, W.C. 2, and lodged in duplicate at his Office in London not later than NOON on WEDNESDAY, the 18th October, 1922.

The Administration does not bind itself to accept the lowest or any Tender. 8768

SITUATIONS OPEN (continued)

PROCESS ENGINEER REQUIRED for Large Turbine and Electrical Work; also PROCESS ENGINEER for Electrical Details (Meters and Instruments). Applicants for the above positions must be thoroughly competent in detailing out operations and times direct from drawings, and possess the necessary practical experience to establish operations and times in the shops. State experience in full, age, and salary required.—Address, 8723, The Engineer Office. 8723 A

REPRESENTATIVE in Every Country for the Sale of the most reliable and up-to-date Quick-grip Engineers' and Woodworkers' Vices, British manufacture. State full particulars of qualification, &c., with references.—Address, P5677, The Engineer Office. P5677 A

REQUIRED by an Important Company, an ASSISTANT BUYER, with experience in Purchasing Engineering Plant and Machinery, preferably in view. Shops Experience. Salary £300, with scope for advancement.—Reply, stating age, education, and experience, to Box B., c/o Regent Advertising Service, Ltd., 4, London Wall-buildings, London, E.C. 2. P5714 A

TRANSFORMER DESIGNING ENGINEER.—APPLICATIONS are REQUESTED for the APPOINTMENT of TRANSFORMER DESIGNER with well-known British firm of electrical engineers.

Applicants must have had first-class experience in the design and manufacture of large High-tension Transformers.

The position would be a permanency and offers ample scope to a suitable man. Applications will be treated with strict confidence.

Address, 8724, The Engineer Office, giving full particulars of experience. 8724 A

WORKS MANAGER REQUIRED for Large Ironfoundry in Scotland; well educated, thoroughly trained engineer, with foundry experience and conversant with the latest labour-saving devices. Good knowledge of C.I. pipe work an advantage. Good organiser and disciplinarian.—Write applications, with experience and salary, "C. K.," c/o Street's, 30, Cornhill, E.C. 3. 8815 A

WORKS MANAGER WANTED for Medium-size mechanical engineering works. Knowledge of modern manufacturing production essential, Railway Permanent Way and Signalling desirable. Applications, stating qualifications and salary required, will be treated in strict confidence.—Address, 8820, The Engineer Office. 8820 A

WANTED, Experienced DRAUGHTSMAN and DESIGNER for Engineering Works near Ipswich; one having had Steam and Electric Winch, Crane and Structural Steel Work experience. Permanent and progressive appointment.—Write, stating full particulars of experience, to the BRITISH STEEL PILING CO., Dock House, Billiter-street, E.C. 3. 8785 A

DRAUGHTSMAN REQUIRED, North-East Coast. Must be thoroughly competent on all classes of Structural Work and Bridge Work; age 30 to 40. Full particulars, stating salary required.—Address, 8775, The Engineer Office. 8775 A

DRAUGHTSMAN and ESTIMATOR REQUIRED for high-class Firm of Heating and Ventilating Engineers in London.—Write, stating age, salary required, and references, to Box 249, Samson Clark and Co., Ltd., 58, Gt. Portland-street, W. 1. 8778 A

FIRST-CLASS DESIGNER WANTED, Familiar with Modern Factory and Workshop Construction. Must be quick and have good theoretical knowledge and be capable of taking out competitive estimates without supervision.—Address, stating full particulars and salary required, 8762, The Engineer Office. 8762 A

HEATING AND VENTILATING. — Capable DRAUGHTSMAN REQUIRED for London Engineer's Office. Must be experienced designer and estimator and used to supervising own contracts. Good salary and prospects for really first-class man.—Address, stating age, experience, &c., P5730, The Engineer Office. P5730 A

A THOROUGHLY COMPETENT FOREMAN WANTED by an old-established Firm manufacturing Steel Castings on the North-East Coast, all classes up to 7 tons in weight; must have held similar position. When applying previous experience must be given and salary required.—Address, 8806, The Engineer Office. 8806 A

REQUIRED, FOREMAN PATTERNMAKER for Engineering Works. Must be a thorough up-to-date reliable man with first-class experience of all classes of patterns, small to medium, also plate moulding.—Write, stating age, experience, and salary expected, to "PATTERN," c/o West End Advertising Agency, Ltd., 195, Oxford-street, London, W. 1. P5686 A

SITUATIONS OPEN (continued)

PATTERNMAKER (WOOD). State Age and Experience.—Apply, P. J. SMITH, 2A, Wynyatt-street, E.C. 8817 A

REQUIRED in Engineering Works, a MAN to Take Charge of and Operate Worm Gear Hobbing Machines. Applicants must have had good practical and technical experience and be capable of securing best results.—Write, stating age, experience, and salary expected, to "WORKS," c/o Dixon's, 193, Oxford-street, London, W. 1. P5685 A

SITUATIONS WANTED

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For continuation of Small Advertisements see page 3.

The Heat Pump.

By T. B. MORLEY, D.Sc., M.I. Mech. E.

MACHINES working on a reversed heat engine cycle have long been known and used for refrigerating. It has also been proposed, though the proposal has not yet been carried out in practice, to use a reversed heat engine for the purpose of heating buildings, and even to attain thereby the required heating effect with a less expenditure of fuel than is required for direct heating with perfect efficiency.*

A third application of the reversed heat engine has recently been developed, and has achieved considerable practical success in the form of what has come to be known as the "heat pump," an apparatus the object of which is to economise heat in evaporating processes, such as the concentration or the distillation of liquids.

A simple and very widely employed method of evaporating is to supply steam to a coil of pipes immersed in the liquid to be evaporated, when, roughly speaking, the condensation of each pound of steam in the coil serves for the evaporation of one pound of liquid. A well-known improvement upon this process is the multiple effect system of evaporation, which was invented nearly a century ago, and which is in world-wide use, particularly for the concentration of sugar juices and soda liquors and for distillation.

In the multiple effect system, steam is supplied to a heating element in the first of a series of vessels, and by its condensation vaporises the liquid in that vessel. The vapour produced is led to the heating element of the second vessel, which contains liquid under a lower pressure, and having therefore a lower boiling-point. The vapour can thus give up its latent heat in the second vessel, causing further evaporation. The vapour from the second vessel is similarly used as the heating medium in a third vessel, and so on. The fall of pressure from vessel to vessel is established and maintained by means of a condenser, to which the vapour from the last vessel is led. The liquid also

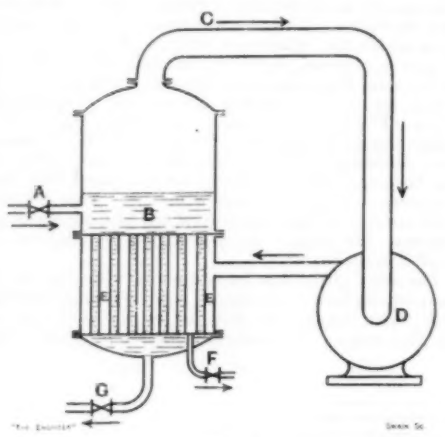


FIG. 1

passes from vessel to vessel, the pressure differences being regulated by cocks in the connecting pipes. The concentrated liquid in the last vessel is usually below atmospheric pressure, and a pump is required to remove it.

The basic principle of the process is that the vapour from the earlier vessels is not allowed to carry away its latent heat to waste. Instead, this heat is utilised to vaporise additional liquid in the succeeding vessel, so that instead of 1 lb. of steam evaporating 1 lb. of liquid, the evaporative effect is multiplied. In practice there is a limit to the number of stages that can be economically used. The increase of evaporation falls off as the stages are added to, so that the total evaporation is not proportional to the number of stages.

In the heat pump process the vapour from the evaporator is taken to a compressor, in which its pressure, and hence also its temperature, are raised to such a degree that the compressed vapour may serve as the heating medium in the evaporator. It is returned to the heating element of the evaporator accordingly, where it is used for the evaporation of a further amount of liquid.

The essentials of one form of the apparatus are shown diagrammatically in Fig. 1. The liquid to be concentrated or distilled enters at A into the vessel B. The vapour passes through the pipe C to the compressor D, and after compression is returned to the heating element E. This may be a coil of pipes immersed in the liquid or the steam may surround a number of tubes containing the liquid. The compressed vapour condenses in E, giving up its latent heat to the liquid. The condensate leaves at F and the concentrated liquid is withdrawn either continuously or intermittently at G.

While in certain circumstances a small quantity of live steam may have to be supplied, in general the only energy required in order to carry on the process is that necessary to drive the compressor. The efficiency of the process from the thermal or energy point of view may therefore be measured by comparing the evaporative effect produced with the power expended in driving the compressor. This power may be derived from fuel consumed in the power unit or station from which the compressor is driven, or, of course, from any other source of power, such as water power, and involve no expenditure of fuel at all. Also the compressor may be driven directly by the prime mover or the drive may be indirect, the transmission being effected electrically. The compressor may also take the form of a jet pump supplied from an external source with steam which mixes with the vapour from the evaporator, and is delivered with it to the heating element. In that case, part of the vapour produced must be allowed to escape, since the vapour is approximately equal to the steam entering the heating element E, and this latter quantity is in excess of the vapour entering the suction branch of the pump by the amount of steam supplied to the jet.

The variations of the process are numerous, but all are characterised by the fact that the vapour produced is compressed and returned to the evaporator as the heating medium.

By means of the heat entropy diagram, the probable performance of the apparatus shown in Fig. 1 can readily be calculated. The results of calculation for a typical case are as follows:—Taking the evaporation pressure as 15 lb. per square inch absolute, the pressure after compression as 19 lb. per square inch absolute, and the internal efficiency of a suitable turbo-compressor as 68 per cent., and its overall efficiency as 63 per cent., the work spent at the compressor shaft per pound of vapour compressed is 21,000 foot-pounds and the total heat of the vapour delivered 1176 B.Th.U. Allowing 1 per cent. for loss by radiation and conduction, the heat delivered to the evaporator is 1164 B.Th.U. This quantity is very

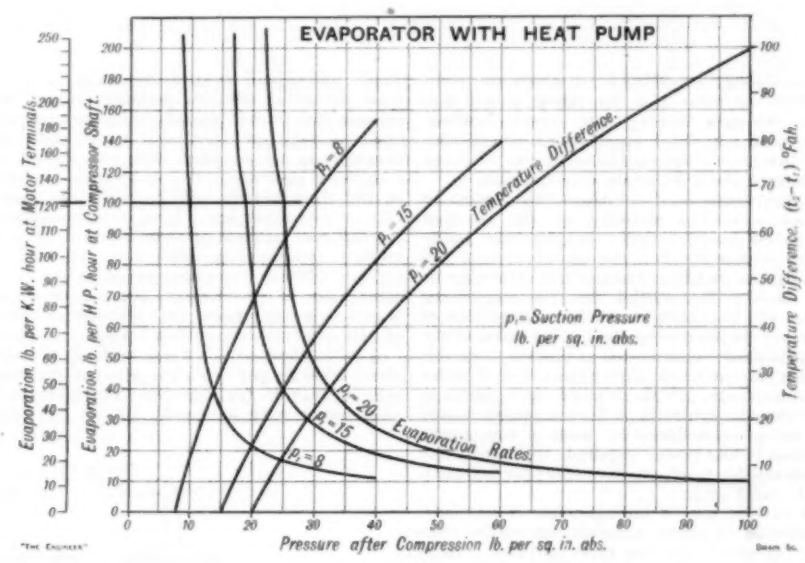

EVAPORATOR WITH HEAT PUMP
Evaporation lb. per K.W. hour at Motor Terminals.
Evaporation lb. per H.P. hour at Compressor Shaft.
Temperature Difference (t₂ − t₁) °Fah.
Pressure after Compression lb. per sq. in. abs.
p₁ = Suction Pressure lb. per sq. in. abs.
p₁ = 8
p₁ = 15
p₁ = 20
Temperature Difference.
Evaporation Rates.
"THE ENGINEER"

FIG. 2

little more than the heat required to heat and evaporate 1 lb. of liquid, assuming a usual initial temperature, and it is sufficient therefore to assume that 1 lb. of compressed vapour evaporates 1 lb. of liquid, and to state the performance of the plant simply in terms of liquid evaporated per kilowatt-hour at the compressor, if it be motor driven. In this case, the evaporation is $\frac{33{,}000 \times 60}{21{,}000} = 94.4$ lb. per horse-power hour. Assuming the motor efficiency to be 90 per cent., this figure is equivalent to 114 lb. per kilowatt-hour at the motor terminals. Assuming, finally, that the prime mover from which the motor is supplied consumes 15 lb. of steam per kilowatt-hour, the result is arrived at that 1 lb. of steam consumed in the prime mover will evaporate 7.6 lb. of liquid.

This figure is influenced very much indeed by the ratio of compression. For example, repeating the above calculation with a compression ratio of 2 to 1, *i.e.*, compressing from 15 lb. to 30 lb. per square inch absolute, and also taking the overall efficiency of the compressor at 0.60 instead of 0.63, on account of the higher compression, the evaporation per kilowatt-hour at the motor becomes 33.5 lb., and that per pound of steam consumed in the prime mover 2.23 lb. Fig. 2 shows how these quantities vary with different degrees of compression. The effective temperature difference between the two sides of the heating surface is practically the difference $(t_2 - t_1)$ of the saturation temperatures at the pressure of the heating steam and at that of evaporation. This temperature difference is also shown in Fig. 2.

From the point of view of maximum thermal efficiency, it is obviously desirable to keep the compression ratio low. Unfortunately, however, such a proceeding also reduces the temperature difference $t_2 - t_1$, and hence reduces the rate of heat transmission in the evaporator. Thus, too low a compression involves either inefficiency of heat transference or else excessively large heating surfaces.

As actually arranged, a distilling plant operated on the heat pump principle includes, as well as the evaporating vessel and the turbo-compressor, a water-purifying plant and a heat exchanger, by means of which the distilled water is cooled by giving up part of its heat to the incoming impure water. There is also a small boiler for supplying auxiliary live steam for starting and for use when the conditions are such that the compressed steam alone is insufficient for the evaporation, these conditions occurring when the plant is working at low output and the temperature difference at the heating surface is small.

Tests on a plant of this description, published in the *Zeitschrift des Vereines deutscher Ingenieure*, January 15th, 1921, show evaporation rates of 76 lb. to 80 lb. per kilowatt-hour at the motor, with no auxiliary steam in use. The pressure in the evaporating vessel was 14.9 lb., and that after compression 19 lb. to 19.5 lb. per square inch absolute, corresponding to a temperature difference of 12.4 deg. to 14 deg. Fah. Assuming the supply current to be generated in a station consuming 15 lb. steam per kilowatt-hour, these test figures correspond to a production of about 5 lb. of distilled water per pound of live steam used, a performance which compares well with that of multiple effect evaporators.

In this instance, of course, it is to be noted that the compression ratio and the temperature difference are low, and hence a very ample heating surface is required. When the temperature difference has to be greater, the evaporation per kilowatt-hour is reduced very much, as is shown by Fig. 2.

Frequently evaporators are operated by exhaust steam instead of live steam. In this case, in estimating the steam or heat consumption of the evaporator, allowance must be made for the fact that power as well as heating effect is obtained from the steam initially generated. It is to be assumed either that there is a demand for power which would have to be met in any case, or else that a market for the power available can be developed.

The evaporating plant must not therefore be debited with all the steam generated. The steam that would be required to produce the same power in a condensing station as is produced by the actual back pressure or extraction engine—or turbine—has to be deducted. Thus, let S_1 be the steam consumption per horse-power hour of the back-pressure engine, and S_2 that of the condensing engine, and let E be the evaporation per hour. The steam required will be k E lb. per hour, where k is 1.1 to 1.2. This is therefore the steam passing through the back-pressure engine, and the power output will be $\frac{k\,E}{S_1}$. The steam required by a condensing engine for the same output would be $\frac{k\,E}{S_1} \times S_2$, and the steam chargeable to the evaporating plant is $k\ E - k\,E\,\frac{S_2}{S_1}$, or per pound of liquid evaporated is $k\left(1 - \frac{S_2}{S_1}\right)$. Under typical conditions of initial pressure and superheat, and with a back-pressure of 5 lb. per square inch above atmosphere, $\frac{S_2}{S_1}$ may be about 0.5, so that the steam consumption of the evaporator is $0.5\,k$, say, 0.55 lb. to 0.6 lb. per pound evaporated, or the evaporation per pound of live steam about 1.7 lb. to 1.8 lb. This figure may be compared with those obtained with the heat pump process in order to compare the relative efficiencies. It is necessary, of course, in a complete investigation of the various types of plant to make allowances also for any heat recovered from the hot

* See THE ENGINEER, February 10th, 1922.

condensate, &c. The above figures are sufficient, however, to indicate that even in comparison with evaporation by exhaust steam, the heat pump process may show a marked advantage under suitable conditions.

Another variation of the process is to use a back-pressure steam engine to drive the compressor directly and to employ the exhaust of the engine to supplement the steam delivered by the compressor as the heating medium for the evaporator. In this case obviously only a part of the vapour produced is taken to the compressor. The arrangement is shown diagrammatically in Fig. 3. It is easy to demonstrate that while this method shows a considerable advantage over direct heating, and may even compete with a double or triple effect evaporator, its economy is markedly below that of the case in which the compressor is driven, either directly or by electrical transmission, from a condensing engine.

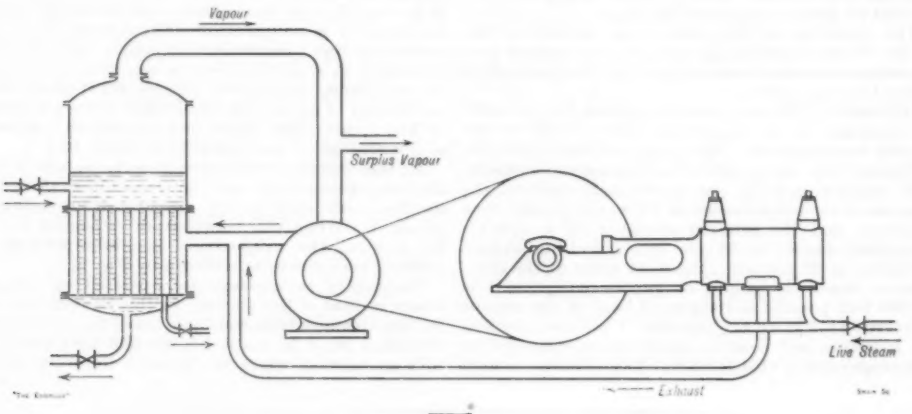


FIG. 3

The case, already mentioned, in which the compressor takes the form of a jet pump is still less economical, though better than direct heating. Nevertheless, it may find applications where simplicity of plant and low initial cost are of more moment than economy in steam consumption.

In the concentration of solutions the change of boiling-point with the strength of the solution requires careful consideration. In the heat pump process, this change involves the compression of the vapour to a pressure higher than would otherwise be necessary, since it is essential that the condensing temperature of the steam in the heating section of the evaporator should exceed the boiling-point of the solution in its most concentrated condition, and this boiling-point may be much higher than that of water at the same pressure. In the type of plant shown in Fig. 1, the compression ratio in the compressor would therefore become considerable, with a consequent large increase in the power required, and conversely a serious diminution in evaporative effect per kilowatt-hour spent—see Fig. 2.

In view of this rise of boiling-point, it has been found advisable to adopt intermittent rather than continuous operation in this type of plant. After the evaporating vessel has been partly filled with dilute liquor, the temperature is raised to the boiling-point by direct steam heating, the vapour pipe being open to the atmosphere. When all the air has been displaced by vapour, the air valve is closed and the compressor started. A small supply of live steam is maintained in order to regulate the process, and, as evaporation proceeds, the level of the liquor is kept constant by the admission of additional liquor. As a result of the increasing concentration, the rate of evaporation continuously diminishes. When it has fallen to a certain rate, the inflow of liquor is stopped and evaporation is continued until any further fall of the level of the liquor would begin to uncover the heating surface. An atmospheric valve on the delivery pipe from the compressor is then opened. The ensuing reduction of pressure in the evaporator is followed by a partial evaporation and cooling of the concentrated liquor. The compressor is then stopped, and the remaining concentrated liquor is removed by means of a pump.

A plant installed in a dyeworks and thus operated has been tested by Professor Stodola—see the *Zeitschrift des Vereines deutscher Ingenieure*, February 18th, 1922. It was designed for an evaporation of 2200 lb. per hour, concentrating soda lye from 5 per cent. to 20 per cent. soda content, further concentration to 35 per cent. being subsequently effected by means of direct steam heating. The incoming liquor was pre-heated in a tubular heater by means of the condensate from the heating element of the evaporator. A six-hour test showed a rise of boiling temperature from 2.9 deg. to 8.7 deg. Cent. above that of water; evaporation, 2580 lb. per hour, falling to 1450 lb.; power supply, 55.5 to 46.4 kilowatts; and evaporation per kilowatt-hour, 46.6 lb. to 31.2 lb. These figures are the mean rates for the first and the sixth hours of the test respectively. No auxiliary steam supply was used during the test. The total evaporation for the whole period was 13,000 lb. water, and the mean rate 41.4 lb. per kilowatt-hour. The condensate is used in the dyeworks, and has therefore to be very pure, being practically equivalent to distilled water.

The advantage of the intermittent method of working is that only the latter period of the operation need be carried out at the higher boiling temperatures, whereas in continuous working the maximum temperature, and hence maximum compression ratio, prevail all the time.

The difficulty arising from the change of boiling-point has also been overcome in the very ingenious manner indicated in Fig. 4. In this apparatus, the evaporation is carried out in stages, the solution entering the vessel A, passing thence to B and C, and leaving C in its most concentrated condition. The pressure is highest in A, and least in C. The vapour from the evaporating vessels is led to the compressor, and enters at different stages corresponding to the different evaporation pressures. Thus, the vapour from C in which the pressure is least enters at the low-pressure end of the compressor, that from B already at higher pressure, enters at a later stage, and that from A later still. All three evaporators are supplied with compressed steam at a uniform pressure. The evaporation temperatures in the three vessels can be made the same if the vapour pressures are adjusted in accordance with the different degrees of concentration, thus giving a uniform temperature difference at each heating surface. While the entire range of pressure in the compressor is considerable, the vapour from vessels B and C is compressed only through reduced ranges of pressure, with a resulting economy of power.

A large plant of this type, with an evaporation of about 8500 lb. per hour, has attained an evaporation rate of 30.8 lb. per kilowatt-hour when working on soda liquor with a specific gravity of 1.38 at the final degree of concentration. In this particular plant the compressor is in two parts, and the plant can be adapted to deal with sulphite solution—for which a lower compression ratio is sufficient—by uncoupling the high-pressure part of the compressor. The evaporation rate is then improved, a test result of 52.8 lb. per kilowatt-hour having been reached.

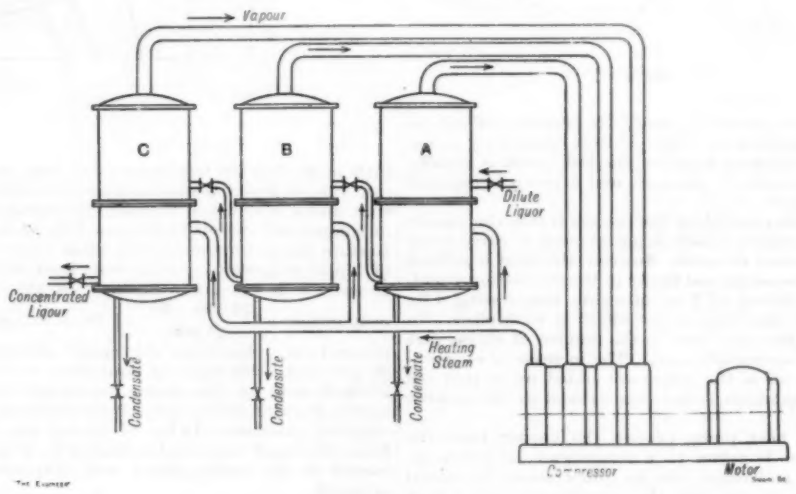


FIG. 4

The heat pump process may also be applied to cases in which evaporation under a vacuum, and consequently at low temperature, is desired, in order to avoid decomposition of the liquids, and it may also be adapted for drying purposes, *e.g.*, the artificial drying of peat. The substance to be dried may be placed in trays in a closed chamber, the vapour from it led to the compressor and the compressed vapour returned to the closed chamber as the heating medium. In order to avoid excessive heating surfaces, the apparatus may be arranged as shown in Fig. 5. Steam at low pressure is circulated by the blower A, and passes through a tubular heater B, where it becomes superheated before it enters the drying chamber C. This superheated steam evaporates the moisture in the material to be dried. Vapour, equivalent in amount to that produced in the drying chamber, is drawn into the compressor D, delivered at higher temperature to the heater B as the heating medium, and condensed there, giving up heat to the circulating steam. Instead of steam, air may be circulated by the blower. In this case, a cooler is required in which the vapour is condensed and separated from the air, and from which after being again vaporised it passes to the compressor. In spite of a two-fold heat transmission being involved, there is an advantage in this arrangement in that drying can be carried

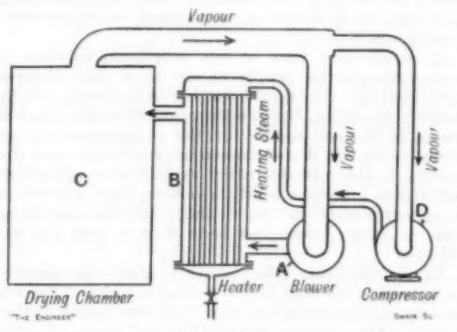


FIG. 5

out at customary pressures and moderate temperatures.

It will be seen that the heat pump process is capable of very many diverse applications. Speaking generally, it is particularly suitable in cases in which evaporation must be carried out at pressures rather higher than atmospheric. That is the very condition in which direct heating by exhaust steam is least economical, as it implies increased heating pressure, and therefore higher back pressure in the engine from which the exhaust is drawn. Thus the power output is reduced, and the greater is the proportion of the total heat originally spent in steam generation which has to be charged against the evaporating plant. Then, also—as can be seen from Fig. 2—the higher the boiling pressure, the greater is the temperature difference $(t_2 - t_1)$ between the two sides of the heating surface, it being pre-supposed that the compression ratio remains constant. This feature is favourable to the efficiency of the heating surfaces. Further, for higher pressures, the compressor is smaller and cheaper.

The heat pump has been applied with success in the manufacture of chemicals, sugar refining, brewing and paper making, as well as for the provision of distilled water. Its suitability for use in drying may be of very great moment in the problem of rendering peat and lignite available as fuels on a large scale. It is being carefully studied and increasingly applied on the Continent, and merits the most careful consideration, particularly in cases in which fuel is scarce and another source of power, such as water, is at hand.

When the world's resources of energy have been under review, it has frequently been pointed out that even if fuel as a source of power could be replaced by other forms of natural energy, such as water, tides and wind, we would still be dependent upon fuel for heating, both domestic and industrial, and that the fuel required for these purposes is enormous in amount. In view of a future possibly fuel-less age, this consideration has given rise to some concern. It is reassuring, therefore, to recognise that in the heat pump is to be found an appliance by which many

industrial processes now involving the expenditure of fuel, may be enabled to transfer their requirements from fuel to other natural sources of energy, and that thus these demands may be met so long as we have a large enough supply of power, even though its source may not be fuel.

Short Histories of Famous Firms.

Contributed by E. L. AHRONS, M.I. Mech. E.

No. XIII.*

R. AND W. HAWTHORN, LESLIE AND CO., LIMITED, NEWCASTLE-ON-TYNE.

THE firm of R. and W. Hawthorn, Leslie and Co., Limited, is one of the oldest in the country, for its origin dates back more than a century; but, unlike some of the famous firms whose histories have been recorded in these columns, it has constantly increased in size, and at the present day is one of the largest and foremost of British firms. Locomotive and marine engine construction and shipbuilding form the principal industries with which its name is connected.

The original works were founded as an open shed in January, 1817, on the east side of Forth Banks, Newcastle, by Mr. Robert Hawthorn, who began the manufacture of stationary steam engines and millwork. There were only four workmen in addition to Mr. Hawthorn, who worked with them. All the machinery was driven by hand. In 1820 Mr. William Hawthorn became a partner with his brother, and from that date the firm was known as R. and W. Hawthorn. The two brothers were the sons of Robert Hawthorn, who for more than fifty years was engineer to the owners of Walbottle Colliery, near Newcastle, and a man of great mechanical ability.

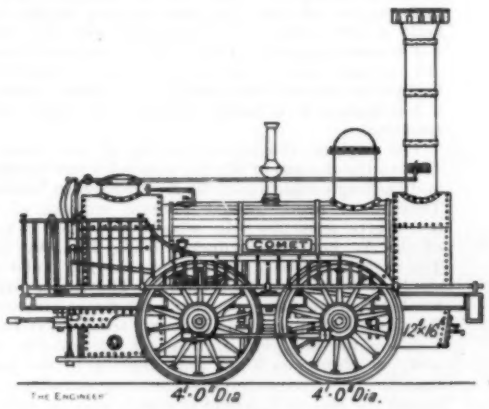


FIG. 1—THE COMET, 1835

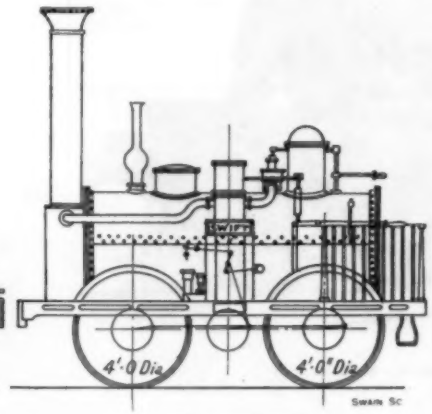


FIG. 2—THE SWIFT, 1836

In 1819 a small portion of the ground upon which the present works stand was purchased. Being on a hill-side, it had to be excavated and prepared for the first workshop by Mr. Hawthorn and his men during the evenings after work hours.

About 1820 the firm made the first steam crane for hoisting ballast from ships. It was erected at St. Anthony's Quay, on the Tyne, and at the same period the marine engineering branch was started. In December, 1822, steam power was first supplied to the works for driving the lathes, which until that time had been driven by men turning a hand wheel. In 1824 a 50 horse-power engine was made for Messrs. Cookson and Cuthbert's glass works, which was quite a show engine for many years. Several small marine engines were constructed at that time for the steam packets which worked on the Tyne. The first of them was only of 7 horse-power, supplied to the packet Indefatigable; but in those made very shortly afterwards the horse-power was increased to 12.

In 1829 a 6 horse-power road locomotive, which was No. 86 in Messrs. Hawthorn's order book, was made for the North Sunderland Lime Works, and was one of the first traction engines constructed in this country. It travelled over the main turnpike road between Newcastle and North Sunderland, and caused no little excitement on the journey. Unfortunately no illustration of it exists.

The first locmotive engine, works order No. 123, was built in 1831 for the Stockton and Darlington Railway, on which it was numbered 13 and named Coronation. It was a six-wheels coupled engine with vertical cylinders 14½in. by 16in. and 4ft. wheels. The connecting-rods worked on a dummy axle, from which motion was communicated to the wheels through the coupling rods. The boiler was of the combined flue and return tube type, 13ft. long by 3ft. 10in. diameter, the return tubes being 106 in number and 1¾in. diameter. A description and illustration of this type of engine and boiler is given in Zerah Colburn's "Locomotive Engineering," page 42. The same year, 1831, a great part of the works and offices were destroyed by fire and had to be rebuilt.

In 1832 Mr. Robert Hawthorn invented and produced a new slide rule for the use of engineers, which was largely adopted in the trade. In 1834 the first Cornish pumping engine made in the district was erected by the firm for the Newcastle Subscription Water Company, under the direction of Mr. Thomas Hawksley. It was followed by several large pumping engines for various collieries, and amongst them was a powerful Cornish engine with cylinders 77in. diameter and 10ft. stroke of 250 nominal horse-power, erected at Walbottle Colliery.

In March, 1835, the Newcastle and Carlisle Railway was opened, and the celebrated engine Comet, made by Messrs. Hawthorn (No. 189), was one of the engines employed. This engine is shown in Fig. 1. It exhibited in many respects a marked advance upon most of the locomotives of that day. The cylinders, 12in. by 16in., were placed inside and inclined slightly upwards, the piston-rod passing beneath the leading axle. The framing was inside the wheels, which had a diameter of 4ft. The chief feature was the use of four fixed excentrics, two on each side, for fore and back gear, instead of the two loose excentrics, which had till then been generally used. In September, 1858, the Comet, which was then past service on the railway, was re-purchased by the firm, and for many years drove the woodworking machinery in the works. It had a tubular boiler 3ft. diameter with a barrel 7ft. 6in. long. The heating surface of the tubes was 237.3 square feet, and of the fire-box 35.2 square feet, total 272.5 square feet. The grate area was 6.4 square feet, and the boiler pressure 60 lb. per square inch.

A very interesting locomotive was the Swift (Hawthorn's No. 199), built in 1836 for the Stockton and Darlington Railway. This engine, which is shown in Fig. 2, was of the 0–4–0 type, and had vertical cylinders, 13in. in diameter by 18in. stroke, which drove an intermediate crank shaft carried across the frames under the boiler. The latter was of "cottage-loaf" section.

The first locomotive to be sent abroad by the firm was built about 1838 to the order of Robert Daglish for the New York, Boston and Providence Railway. The only available particulars are that the cylinders were 12in. by 18in. and that the pressure was 50 lb. per square inch.

Two extraordinary engines were constructed to Harrison's patent for the Great Western Railway (7ft. gauge) in 1838 to the orders of Brunel. They had the cylinders and motion on a separate carriage from the boiler. The steam was conveyed to the cylinders through a jointed pipe, and a similar pipe was used for the exhaust to the chimney. The driver stood in front of the driving axle on the engine carriage, and the fireman behind the fire-box in the usual manner. The boiler and fire-box, and also the frames on which they were placed, were similar in both engines, and the cylinders, 16in. by 20in., were of the same dimensions. The boilers contained 135 brass tubes, and the copper fire-box was divided by a mid partition. The working pressure was only 50 lb. per square inch and the total heating surface 624 square feet, of which the fire-box supplied 108 square feet. These two well-known engines were named "Hurricane" and "Thunderer." The engine Hurricane had driving wheels 10ft. diameter, and the connecting-rods drove the driving axle directly in the usual way. The weight of the engine was only 11 tons, of which 6 tons were carried on the driving wheels. The Thunderer had four 6ft. coupled wheels, which were driven by gearing in the ratio of 3 to 1, thus being equivalent to a driving wheel 18ft. diameter. The connecting-rods drove a spur wheel 4ft. 6in. diameter, which was fitted with hard wood teeth, the pinion, 1ft. 6in. diameter, being mounted on the driving axle. The weight of the engine carriage was 12 tons 14 cwt. and that of the boiler carriage 17 tons 10 cwt.

In 1839–1840 Messrs. Hawthorn patented several interesting improvements in locomotive engines. The first was the perforated steam pipe, intended to dispense with the steam dome. The specification stated that ¼in. holes were used, the holes being more widely separated at the smoke-box end than at the fire-box end, and their total area was to be about one-fourth more than the cross-sectional area of the steam pipe. The perforated steam pipe was long used by various locomotive engineers, notably by Messrs. Patrick and James Stirling. In this connection it may be mentioned that Mr. Patrick Stirling was manager of one of the departments of Messrs. Hawthorn's works for a period prior to 1853, when he became chief locomotive engineer of the Glasgow and South-Western Railway.

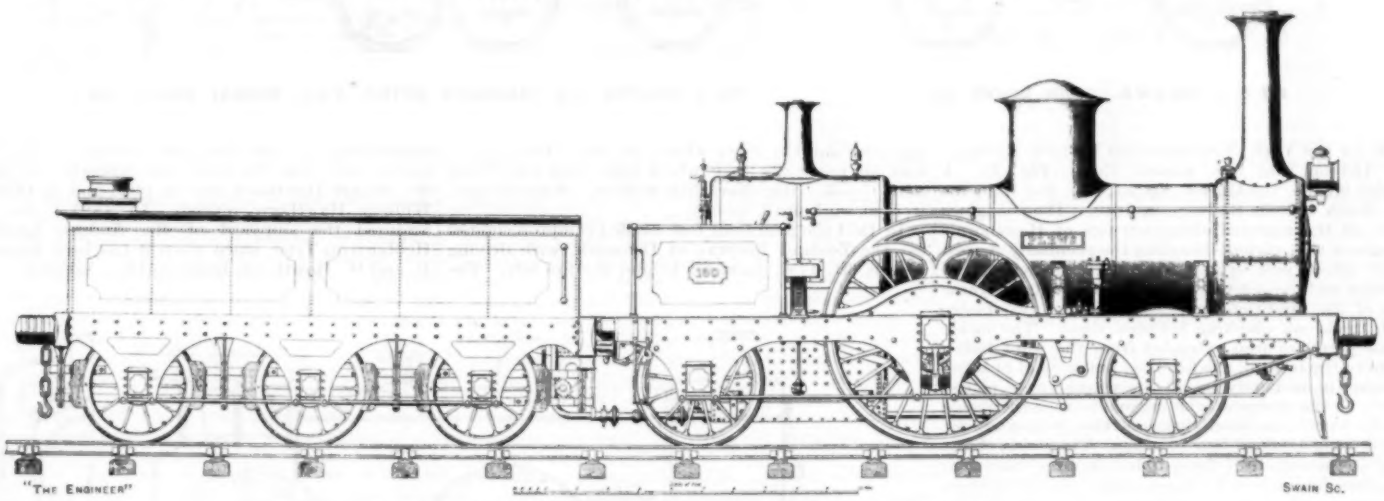


FIG. 3—THE PLEWS, YORK, NEWCASTLE AND BERWICK RAILWAY, 1848

In the same specification Messrs. Hawthorn patented a steam drying or superheating apparatus for locomotives. It consisted of a steam chamber in the upper part of the smoke-box with connections to the cylinders. A number of vertical tubes passed through the chamber, and through them the furnace gases passed on their way to the chimney. In another design the fire-box was divided into two portions with semi-circular crowns with a water space or mid-feather between them. This idea was afterwards used in a modified form by Mr. McConnell in his coal-burning fire-boxes.

An interesting engine was built in 1840 for the Newcastle and North Shields Railway. This was a goods engine of the 0–4–2 type, but the chimney,

* No. XII. appeared July 15th, 1921.

being placed at the back, gave it the appearance of a 2–4–0 type. It had a return-tube boiler with the double fire-boxes having semi-circular crowns of the form mentioned above. This type of fire-box was probably adopted to avoid the necessity for roof stays, which would have been in the way of the return tubes. The superheater or steam dryer was also provided in this engine. The cylinders were 14in. by 18in. and the coupled wheels 4ft. 9in. diameter.

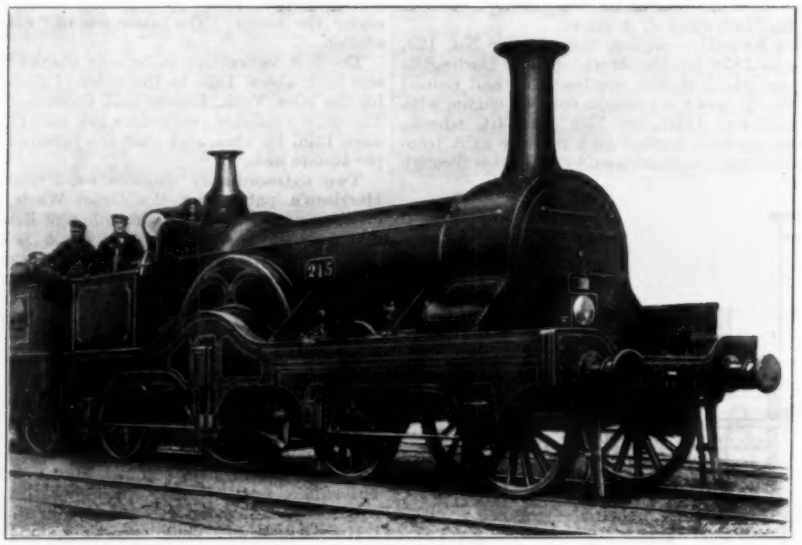


FIG. 4—G.W.R. SINGLE DRIVER, No. 215, 1853

In 1845 another disastrous fire occurred and completely destroyed the locomotive shops with many engines and tenders, both completed and in progress. In 1847–8 several large waterworks pumping engines were built for Derby, Wolverhampton, Southampton, Brighton and Coventry.

A celebrated express engine was built in December, 1848, for the York, Newcastle and Berwick Railway, No. 180 on that line, named Plews (Fig. 3). A similar engine, the Queen, No. 57, was also built for the North British Railway in 1849. These engines show all the external characteristics of Hawthorn's designs of that period, including the peculiarly shaped dome cover and splashers. The arrangement of framing and motion was peculiar. The outside frame was of the sandwich type, consisting of two plates with thick oak planking between them. The inside frame plates of iron extended from the front buffer beam to the front of the fire-box, but instead of being situated immediately inside the wheels, were placed nearer to the centre of the engine, so that the inside cranks worked between them and the driving wheels. The driving axle had four bearings. The steam chests were on the outside of the cylinders, and the valve gear was therefore driven by an excentric placed between the driving wheels and the outside frames. The driving wheels were 7ft. diameter and the cylinders 16in. by 20in. The boiler was oval in section. 4ft. across the vertical, and 3ft. 10in. across the horizontal diameter, and had, therefore, to be stayed transversely.

Another celebrated express engine was the Great Northern single driving wheel engine, No. 215, with leading bogie, designed by Mr. Archibald Sturrock (Fig. 4). This engine, built in 1853, had 7ft. 6in. driving wheels, 4ft. 3in. bogie and trailing wheels, and 17in. by 24in. cylinders. The total wheel base was 21ft. 8½in. The boiler was extremely large for the period, and had a tube heating surface of 1564 square feet, to which the fire-box, which had a mid-feather partition, added 155.2 square feet, making a total of 1719.2 square feet. The special Hawthorn features included the domeless boiler with perforated steam pipe and the provision of compensating levers between the springs. To Messrs. Hawthorn must be ascribed the credit for introducing equalising levers into this country in 1851, though they had previously been used in American practice.

The swivelling bogie of No. 215 was peculiar, in that it had outside sandwich framing with very little clearance between the latter and the bottom of the main sandwich frame of the engine. The writer has heard it stated that the oak planking of the two frames tended to swell, with the result that the insufficient clearance between them caused them to come into contact and thus prevented the bogie from swivelling freely.

A series of 4–4–0 engines was built for the Arica and Tacua Railway (5ft. 6in. gauge), Chile, in 1854. These were the first locomotives built for the main lines of that country. The cylinders, 15in. by 26in., were inside. The coupled wheels were 4ft. 6in. diameter and the bogie wheels 2ft. 9in. The engines had an unusually long wheel base, and were fitted with Gooch's stationary link motion. Some of them were at work until recently.

In 1854 the firm built four single Crampton engines for the Zealand Railway of Denmark, with driving wheels 6ft. 1½in. diameter behind the fire-box. The carrying wheels were 3ft. 7in. diameter, and the cylinders, 15in. by 22in., were placed between the inner and outer frames. The carrying wheels had bearings in the outer frames only, but the driving wheels had inside bearings only. The Crampton regulator box on the boiler, so long used in France, was employed. These engines weighed 25¼ tons, of which 11 tons were available for adhesion.

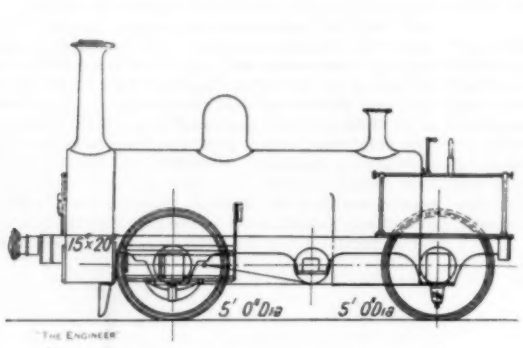


FIG. 5—G. AND S.W.R., GOODS ENGINE, 1855

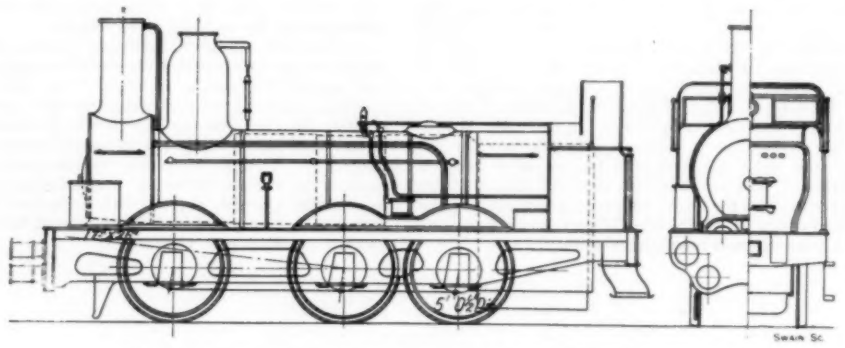


FIG. 6—STOCKTON AND DARLINGTON SECTION, N.E.R., MINERAL ENGINE, 1868

The engines illustrated in Fig. 5 were unique. They were four-wheeled goods engines, built in 1855 for the Glasgow and South-Western Railway, during the period when Mr. Patrick Stirling was chief locomotive superintendent of that railway. They had one feature in common with Crampton's design—with intermediate dummy crank shaft, but with the important difference that this shaft was driven from outside instead of inside cylinders. The 5ft. wheels were spaced 12ft. 1in. apart and connected by coupling rods to the intermediate shaft. The cylinders were 15in. by 20in.

Messrs. Hawthorn were the first firm in this country which designed and constructed four wheels coupled Crampton engines of the type so long used on the Eastern and other railways of France. The outside cylinders were placed near the centre of the engine and drove the trailing axle, which was behind the fire-box and coupled to an axle in front of the fire-box. For the East Kent Railway, afterwards the London, Chatham and Dover Railway, six passenger saddle-tank engines of this type with leading bogies were built in 1857, and were followed in 1861–2 by eight 4–4–0 tender engines. The coupled Crampton engines did not find much favour in this country, and after a few years' service were completely reconstructed as 2–4–0 engines with inside cylinders, the bogies being removed.

The engines illustrated in Fig. 6 were built in 1868 to the designs of Mr. W. Bouch for the Stockton and Darlington section of the North-Eastern Railway. They were inside-framed mineral engines of the 0–6–0 type with 5ft. 0½in. wheels, all placed in front of the fire-box, the cylinders being 17in. by 26in. The main features of interest were in the boiler and the feed-water heating system. The boiler had a fire-box with a flat top, stayed by direct stays to a flat outside wrapper plate in a very similar way to the Belpaire fire-box, but the top of the outside shell wrapper plate was lower than the top of the boiler barrel. The feed water was led to an annular space round the chimney, where it was heated by exhaust steam taken from a pipe which was connected to an exhaust space just below the base of the blast pipe. The fire-box was provided with a mid-feather. Five very similar engines were built by Messrs. Hawthorn for the same railway in 1870, in which the piston stroke was lengthened to 28in., then the longest in this country.

Before dealing with the shipbuilding and marine departments of the firm, the account of the locomotive side may be more conveniently concluded. Mr. Robert Hawthorn died in 1867, and in 1870 Mr. William Hawthorn retired. In 1883–4 the firm acquired the shipyard of Mr. Andrew Leslie at Hebburn-on-Tyne, since when it has been known as R. and W. Hawthorn, Leslie and Co., Limited.

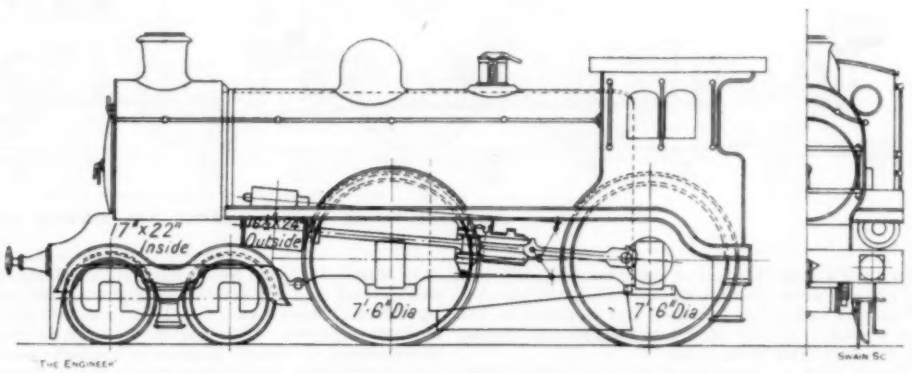


FIG. 7—ENGINE BUILT TO WINBY'S DESIGN FOR THE CHICAGO EXHIBITION, 1893

Various locomotives of the "Fairlie" type have been constructed at Forth Banks Works, the earliest of which were built for the Nassjö and Oscarshamn Railway, Sweden, in 1874. Two interesting 0–4–4–0 engines of this type were built in 1885 to the order of Mr. R. F. Fairlie for the Saxon Government Railways, and are the only engines built by a British firm for a German railway since 1874. They were narrow-

gauge engines with 8½in. by 14in. cylinders and 2ft. 8in. wheels. The boilers were of unusual design. The front plate was circular, 2ft. 7in. diameter, but the back plate was of oval section with flat sides. The middle plate was coned at the top to join the front and back plates, and together with the back plate was stayed across the flat sides by a single row of ⅞in. transverse stays. The engines were fitted with spark-arrester chimneys.

At the Chicago Exhibition of 1893 an engine (Fig. 7) of Mr. F. C. Winby's design, built by Messrs. Hawthorn, Leslie and Co., was on view. It was of the 4–2–2–0 type with uncoupled driving wheels 7ft. 6in. diameter and bogie wheels 4ft. diameter. The inside cylinders, 17in. by 22in., had link motion and drove the front pair of driving wheels; the outside cylinders, 16½in. by 24in., had Joy's valve gear and drove the rear axle. In order to admit it between the large driving wheels the boiler was of oval section with flat sides stayed transversely. The fire-box tube plate was set back behind the front plate by an amount equal to about half the length of the box, and the smoke-box tube plate extended well into the smoke-box. Illustrations and a description of this curious engine appeared in THE ENGINEER of April 28th and May 5th, 1893. It ran a number of trial trips on the Chicago and North-Western Railway, but did not suit American ideas, and was relegated for some time to a siding in the locomotive yard, where it was shown as a curiosity.

For many years the firm has constructed engines of various modern designs and all gauges for British, Imperial, and foreign railways. An example of a modern design is shown in Fig. 8, which illustrates one of the latest engines in the "Clan" class, built for the Highland Railway to the designs of Mr. Cuming, chief locomotive engineer of that railway. This is of the 4–6–0 type, with 6ft. coupled wheels and 21in. by 26in. cylinders. The coupled wheel base is 14ft. and the total 25ft. 9in.; tube heating surface, 1328 square feet; fire-box heating surface, 139 square feet; total water heating surface, 1467 square feet; additional superheating surface, 256 square feet; grate area, 25.5 square feet; weight on coupled wheels, 45½ tons; total weight in working order, 62¼ tons; total weight of engine and tender, 104.35 tons.

No history of Messrs. R. and W. Hawthorn, Leslie and Co.'s Forth Banks Works would be complete without mention of the large number of tank locomotives which have been built for industrial works and collieries. Crane locomotives form a speciality of the firm's manufactures, and petrol and electric locomotives have from time to time been constructed.

MARINE ENGINES.

Turning now to the marine engine and shipbuilding side of the firm's production, the year 1852 saw a great advance of iron shipbuilding on the Tyne, and Messrs. Hawthorn determined to make this a prominent part of their business. During the few following years they manufactured 200 sets of marine engines, aggregating about 100,000 indicated horse-power for merchant vessels, including a large number of screw colliers. The total indicated horse-power may appear somewhat small when compared with 25,000 indicated horse-power of the battleship Collingwood, for which Hawthorn, Leslie and Co., Limited, constructed the machinery in 1908, but, taking into consideration the average horse-power of the large ships of those days, it will be seen that some of the highest-powered vessels of the time were engined by the Forth Banks Works.

In 1862 the firm received its first order from the British Government for a set of direct-acting screw engines for the gunboat Shearwater. These engines were of 150 nominal horse-power, and in them expansive working was carried out to a greater extent than ever before in the Navy by means of a separate valve worked by excentrics and link.

In 1870 the firm secured a large site at St. Peter's, which had previously been a shipbuilding yard. At these new works a pair of 80-ton sheer legs was erected, which were then the largest on the river Tyne. In 1870–1 the firm persuaded several of their shipowning customers to adopt engines of the compound type and to work them at the highest pressures practicable in those days. In 1872, when the average indicated horse-power was under 1000 and engines of 2000 indicated horse-power were considered to be specially powerful, the firm engined three large vessels for the Lavarello Line, the Khiva, Kashgar, Deccan, and Poona, for the P. and O., and other boats for various shipowning firms, all of which were of powers ranging from 2000 indicated horse-power upwards. In 1874 three gunboats for the British Navy were fitted with horizontal compound surface condensing engines, and they were followed by orders for the engines of four cruisers, the Diamond, Sapphire, Garnet, and Tourmaline.

In 1879 the firm built engines for warships for the Chinese Government. The first of these were engines for four gunboats, and were followed by the machinery for four cruisers, in which a new departure was made by obtaining a very much higher horse-power per ton of material than had hitherto been obtained in marine machinery.

The vessels fitted with this type of machinery were so successful that the firm was entrusted with orders for the Chilean warship Esmeralda and several warships for the Italian Government. The latter were the first triple-expansion engines built by the firm. In 1882 the whole of the marine work was transferred to St. Peter's Works, and the works at Forth Banks were entirely devoted to the construction of locomotives, though circumstances have since made it desirable to construct boilers there, and at the present time all water-tube boiler work is carried out in that department.

In 1853 what is now the shipbuilding yard was established at Hebburn by the late Mr. Andrew Leslie, and although doing business together, Messrs. A. Leslie and Co. and Messrs. R. and W. Hawthorn were independent firms, and remained so until 1885, when they amalgamated. During the period before the amalgamation 265 ships were constructed for many of the best-known British and foreign lines. After the amalgamation nearly all the high-speed vessels of the Russian volunteer fleet were built at Hebburn, including the 20-knot boat Smolensk.

To give a list of all the vessels built and engined by the firm would take up too much space. Special mention may be made of the British torpedo-boat destroyer Viper, as she was the first vessel, other than the experimental Turbinia, to be supplied with steam turbines, and by attaining a speed of 37 knots proved herself to be the fastest vessel of her day. A later destroyer of the "River" class achieved the result, during her coal consumption trials, of steaming 31 knots per ton of coal consumed.

A special type of vessel, the Vollrath Tham, was designed and built for a Swedish company for the purpose of carrying iron ore from Narvik. In place of the usual holds and derricks, a special arrangement of gravity discharge ore hoppers is fitted. Between the hoppers are placed discharge compartments, which give direct access from the deck to the discharge chutes from the hoppers at the bottom of the ship, and by means of iron skips and a special type of electric crane the discharge is effected with a minimum expenditure of labour and fuel.

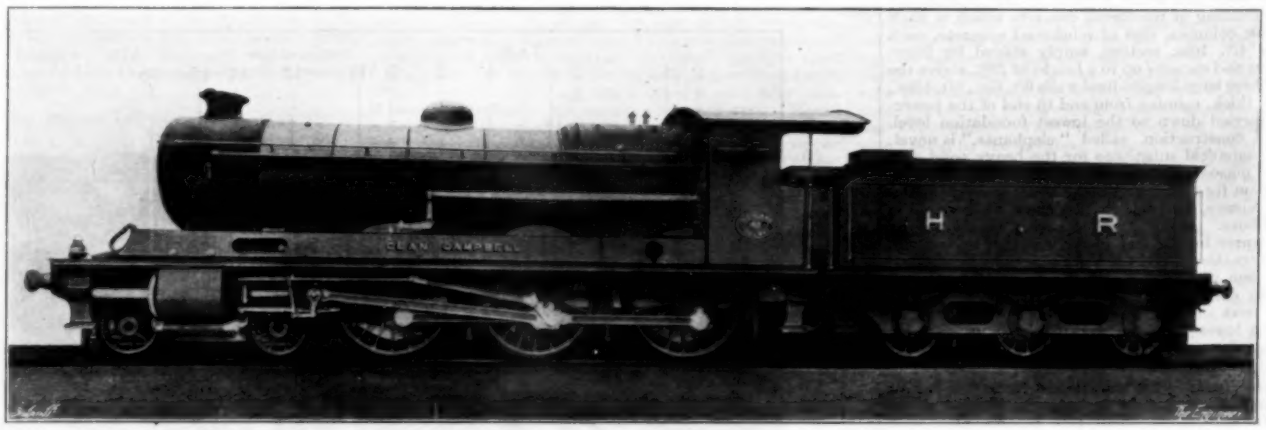


FIG. 8—HIGHLAND RAILWAY, EXPRESS PASSENGER ENGINE

THE recent quest for oil at several places near Chesterfield has proved a failure, and the pumping plant installed there has just been sold by auction. Representatives were present of foreign oil companies, and secured most of the lots, the sale producing about £16,000. Four storage tanks, of 160,000 gallons capacity, reached an average of £510, and six of 5250 gallons capacity brought from £80 to £100 each. About 150 tons of tubes brought over from America at a cost of £30 per ton were sold at £8 per ton. The well at Hardstoft, in Derbyshire, is still being worked.

The Gennevilliers Central Power Station.

THE following description of the vast central power station just outside Paris, which was opened on July 6th by Monsieur Le Trocquer, Minister for Public Works, was prepared for the summer meeting of the Institution of Mechanical Engineers, and is borrowed from a pamphlet issued by the Institution.

The new electric generating station at Gennevilliers—the largest in the world—has already formed the subject of several notices in the technical Press. The first unit of 40,000 kilowatts was put into work early in the present year.

At the date of the Armistice the question of the electric supply to the suburbs of Paris required complete revision. The local generating stations, which had been called upon to supply ever-increasing quantities of current for the manufacture of munitions during the war, were now in such bad condition that very great expenditure would have been required to put them in normal working order; but supposing that such expenditure could have been incurred, and the cost carried by the companies, the reconstruction would not have eliminated the disadvantages of the pre-war distribution of current which varied from station to station. Some generated three-phase and others two-phase alternating current at four different periodicities, 53, 50, 42, and 25 per second; there was almost infinite variation in the voltage and generally the conditions were such that it was impossible for one station to help another in case of difficulty.

In order to deal with this problem some of the manufacturers and engineers suggested a complete scheme of reorganisation for the distribution of electric energy; for this it was necessary that the various supply companies should appreciate that the scheme was one of mutual advantage, and, when this had been agreed, the French Union d'Electricité was formed in August, 1919, with the object of producing the design and carrying the work to completion.

The general specification for the station intended to supply current to the whole of the suburbs of Paris was as follows:—

(*a*) A central generating station capable of giving 200,000-kilowatt three-phase 50 periods current at 6000 volts and the successive shutting down of the existing generating stations as the units of the Gennevilliers central station came into work, these being purchased by the Union d'Electricité, six large companies being concerned.

(*b*) The construction of a large system of mains for the current produced at Gennevilliers with an underground ring main encircling Paris and overhead branches to Creil, Mantes, Versailles, Corbeil and Meaux.

(*c*) The construction of a sub-station or of sub-stations for each of the existing companies which would cease to generate, but continue to supply current reduced from 60,000 volts to that in use in the zone (or sector) of each company.

The financial aspect of the problem, which involved a capital sum of 250 million francs, referred to the great saving to be effected per kilowatt-hour by generating at high voltage at a very large generating station with the most modern plant and the minimum of labour, as compared with the costs at the existing generating stations. As a basis the cost of coal delivered in the Paris area was taken at 60f. per ton; the conclusions will be further confirmed if, as unfortunately appears probable, the cost of coal should remain above 60f. per ton.

The scheme has received the approval of the great Public Works Departments and is in complete harmony with the general scheme for the unification of the whole of the supplies of energy throughout France now under consideration by the Ministry of Public Works. At the proper time it can be linked up with the central hydro-electric supplies of the Rhone, the Rhine or the Central highlands, and ultimately of the group of generating stations in the mining district of the Pas de Calais. To the influence of the Ministry of Public Works is due a large share of the credit for the wide scope of this work.

DESCRIPTION OF THE GENNEVILLIERS GENERATING STATION.

The site of the station has an area of 10 hectares (120,000 square yards), and is bounded on the north by the Seine, on the east by the railway from Paris to Mantes, on the south by the old Argenteuil road, and on the west by Departmental road No. 8. The generating station includes:

(1) The power-house proper, with, as annexe on the west side, the transformer house, and the low-tension switchboard room.

(2) The boiler-house to the east of the power-house.

(3) The high-tension switchboard room to the west of the low-tension switchboard room and separated from it by a covered yard with a glass roof.

(4) On the front of the buildings, between them and the river, are the offices. In addition, there are the waterways for the water intake and return to the river after passing through the condensers, and a quay 240ft. long arranged above the intake. Last there is a coal yard 220 yards long by 44 yards wide running in front of the buildings for their whole width and equipped with two travelling gantries. The works are connected with the railway by a temporary siding which will later be replaced by another of much greater importance for the joint use of the Union d'Electricité and the future port of the City of Paris at Gennevilliers.

Power-house.—The power-house itself is a steel-framed structure with reinforced concrete foundation carried on piles and with brick filling. The height overall, from the lowest point of the foundations to the ridge of the roof, is 42.35 m. (139ft.). The roof principals are spaced 36ft. centres. The plant will consist of five turbo-alternators, each 40,000 kilowatts, and the south end of the building is of temporary construction, leaving provision for extension to hold eight generating sets in all. The base of each generator is 56ft. above the bottom of the foundations on an open framing of reinforced concrete which is itself carried on six columns, also of reinforced concrete, each 6ft. 6in. by 4ft. 10in. section, amply stayed by intermediate floors and *encastré* up to a height of 25ft. above the footings by three large longitudinal walls 6ft. 6in., 6ft. 10in., and 7ft. 6in. thick, running from end to end of the power-house and carried down to the lowest foundation level. This form of construction, called "elephants," is novel, and is an economical substitute for the heavy solid concrete or solid masonry foundations. The cellular construction gives room for the arrangement of accessories such as pumps, condensers, &c., and enables space to be saved in the power-house. A still further saving is effected by taking the water intake and return through underneath the turbo-alternators. There are two superposed travelling cranes, the one of 20 tons and the other of 100 tons, running from end to end of the power-house. Finally, on the side next to the transformer house there are two passages, the lower providing for the entry of cold air, after filtering, for cooling the alternators, and the upper passage for leading the cables.

Transformer House.—The transformer house to the west of the power-house and of the same length consists of two rows of metal stanchions, about 17ft. centres, filled with brick partitions and carrying a reinforced concrete flat roof. It contains the main step-up transformers in cells, the base of which is 36ft. above the bottom of the foundations; these cells are covered at the top, at the height of 56ft. above foundation level, by removable slabs of reinforced concrete, which also form the flooring above them.

Low-tension Switchboard Room.—This building, adjoining the preceding on its west side, is also metal framed, but of very light construction, with brick filling, both solid and perforated, and lined with tiles; it is 23ft. wide and 280ft. long, enclosing, at a height of 36ft. above foundations, a gallery 6ft. 6in. wide in the lower portion of the building, containing the main transformer switches, and alongside this a span 16ft. 4in. wide containing the laboratory and the auxiliary transformers. There are also two other floors at heights of 56ft. and 69ft. respectively above foundations; of these, the lower carries the auxiliary 3000-volt switchboards and the small wir[illegible]witches; the upper floor carries the 60,000-volt and also 3000-volt switchboards, as well as the continuous-current 500-volt board and the three-phase 220-volt board. It also comprises the dispatching gear and the main telephone exchange as well as the air filters arranged at the north end.

Boiler-house.—The boiler-house is entirely of reinforced concrete carried on blocks resting on groups of piles. The stanchions commencing at 109ft. above foundation level, and the roof principals are the only metal portions of the structure. The boiler-house is 150ft. wide by 283ft. long. The roof principals rest on shoes at 160ft. above foundations, giving 86ft. of head room in the building.

There are two rows of boilers arranged lengthwise of the building consisting of ten Babcock boilers in pairs with 10ft. clear way between the pairs, and arranged for firing ultimately with *mazout*, and the other row consisting of five Stirling boilers. This installation corresponds to the five turbo-alternators to be erected in the power-house; provision has been made for extensions in both the boiler and power-houses. The two rows of boilers are separated by a central gangway 28ft. wide and at the sides there are gangways 22ft. wide on the Babcock and 23ft. on the Stirling side; these are connected by six cross ways each about 10ft. wide.

A large basement extends under the boiler-house at a height of 33ft. above foundations, and carries the various railway tracks necessary for removal of clinkers, ash, &c. Above this a floor at 46ft. above foundations carries the piping, and a third floor at 56ft. above foundations on the level with the power-house floor forms the actual firing floor. Bins of reinforced concrete are arranged in the ways between the boilers of a size sufficient to contain a total of about 3800 tons of coal.

High-tension Switchboard Room.—This building, arranged to the west of the low-tension switchboard, is constructed entirely of reinforced concrete, the construction consisting of piers and cross members carrying a roof with a slight fall each way. The north and west walls are filled with white brickwork; the south end has a temporary metal end. There is a passage way round the upper part of the building with staircases, and communicating with both the high and low-tension switchboard rooms.

Water Conduits: Intake.—This consists of two channels of reinforced concrete 6ft. 6in. wide by 14ft. 6in. deep separated by a wall 1ft. thick and both communicating with the common lodge from which the water is drawn. *Return.*—Under the power-house is a single conduit, 12ft. 6in. by 16ft. 10in., which is divided on leaving the building into two, measuring 8ft. 1in. by 6ft. 4in., separated by a wall 1ft. thick, and arranged obliquely in plan so as to deliver into the river about 450ft. below the intake. Arrangements are provided for maintaining the water level even in time of drought.

Lodge.—The lodge is 92ft. long by 34ft. wide, and is arranged with seven inlet channels fitted with screens and strainers for removing dirt and foreign matter from the water; a well sunk below the lodge serves to feed the pumps used for clearing the screens and strainers.

The Quay Wall is built of reinforced concrete with an outer slope of 63 deg., the top being at 34ft. above foundation level, and is stiffened with reinforced concrete work on the inside. The coal store is arranged 26ft. 6in. above foundation level parallel to the river between the main buildings and the river; it measures 650ft. by 130ft. It is enclosed by a wall on the side nearest the river and by earth embankments covered with reinforced concrete on the other sides. A travelling gantry transfers the coal to the store. Railway tracks running at the quay level serve for handling wagons.

Plant.—The five turbo-alternators are of 40,000 kilowatts each, one being supplied by Escher Wyss (Switzerland), and the others half by the Société Alsacienne de Constructions Mécaniques, and half by Messrs. Schneider and Cie. The steam pressure is 22 kilos. per square centimetre (310 lb. per square inch), and the turbines run at 1500 revolutions per minute. The alternators have closed-circuit air cooling, with make-up of filtered air; the tension of the terminals is 6000 volts.

Each turbo-alternator group delivers to three single-phase step-up transformers raising the voltage to 60,000 and connected direct to the high-tension switchboard, where they feed the 60,000-volt bars to which the sub-station feeders are connected.

The particulars of the boilers are:—Working pressure, 350 lb. per square inch; temperature of superheated steam, 375 deg. to 400 deg. Cent.; heating surface per boiler, Babcock, 14,000 square feet; Stirling, 22,500 square feet; evaporation per hour, Babcock, 117,000 lb.; Stirling, 176,000 lb.; forcing fans and induced draught. The feed water from the condensers is heated to 80 deg. Cent. at the turbine, and further to 100 deg. by the exhaust from the auxiliary machines; then after de-gassing it passes through steel economisers above each boiler, leaving these at about 160 deg. Cent. to enter the boiler. The gases leave the boiler at 340 deg. Cent., and fall to 220 deg. Cent. in passing through the economiser, and then in passing through the air heaters they are further reduced to 150 deg. Cent. The air forced under the grates passes through the heaters, and is raised to about 90 deg. Cent. before entering the fire. The economisers have 13,000 square feet surface for each Stirling boiler and 17,000 square feet for each pair of Babcock boilers. The condensers have 37,000 square feet cooling surface and are supplied by two circulating pumps each capable of delivering 6750 tons of water per hour (for the whole eight sets, two standing by and six running, this will be equal to 9 tons of water per second).

The level of the yard and works has been arranged to come above the highest flood mark of the Seine.

When fully equipped, the station will have cost a little under 600f. per kilowatt, on the 200,000 kilowatt basis, a figure which will be reduced to 350f. when the output reaches 320,000 kilowatts; this is about the same as the mean figure for installations equipped before the war. The area of power-house per kilowatt is 1.18 square feet, and the area of boiler-house 2.36 square feet.

The station is not yet complete, but it has relieved the situation of the supplying companies, which had reached the stage of being unable to supply new demands. The standardising of the three-phase current at 50 periods, which will shortly be effected, will do much to simplify the construction of motors and to reduce the cost to the consumer.

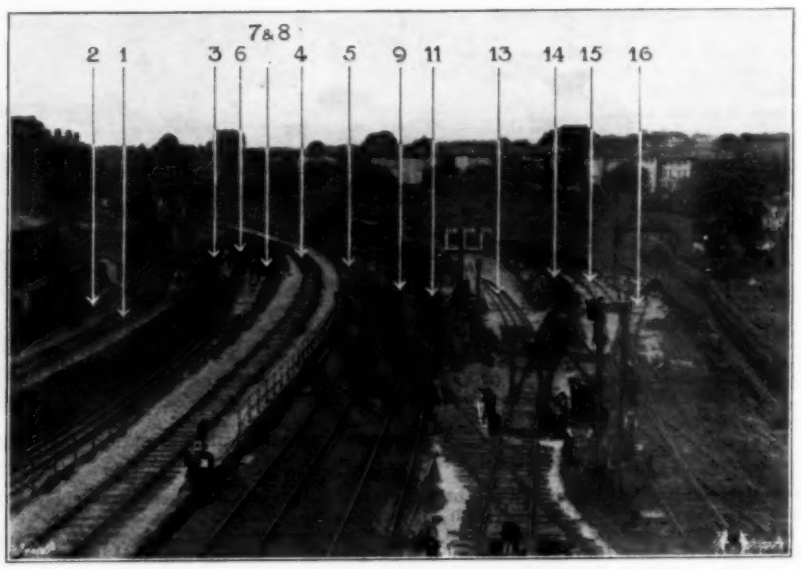
The Chalk Farm Widening, L. and N.-W. Rly.

IN the session of 1907 the London and North-Western Railway Company obtained powers for new railways and widenings between Euston and Watford; for the widening of the Rickmansworth branch; and for the construction of a line to Croxley Green.

On Monday last, July 10th, the last item in this programme of improvements—the widening between Chalk Farm and Queen's Park—was brought into use, together with an electrical service to and from Euston station, and to and from Broad-street *viâ* Chalk Farm.

QUEEN'S PARK TO CHALK FARM SECTION.

It will be recalled that the London Electric Company's line comes in from Paddington at Queen's Park, having passed under the North-Western main line by tubes. On each side of the Bakerloo lines at Queen's Park station is the usual platform with the station buildings and outside them are the London and North-Western up and down electric lines, the junctions with the Bakerloo lines being made on the Willesden side of the station. The widening is continued thence through Kilburn and South Hampstead stations—the latter used to be called Loudoun-road



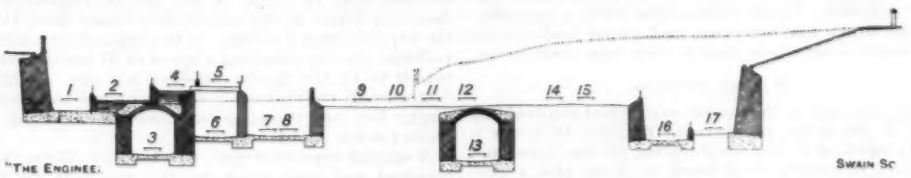
THE CHALK FARM WIDENING, L. AND N.W. RAILWAY

—which have been reconstructed, to the eastern end of Primrose Hill tunnel. This tunnel is 1330 yards long, and was doubled in 1878, when the up and down slow lines from Willesden (opened in 1859) were continued and joined the Chalk Farm-Euston slow lines. The electric lines have been carried under Primrose Hill in twin tubes, each 16ft. 4in. diameter.

THE JUNCTION AT CHALK FARM.

Between the eastern (Euston end) portal of Primrose Hill tunnel and the bridge which carries Regent's Park-road over the main line, a distance of over 500 yards, the four lines of way that had passed through the north and south tunnels had become nine running lines, whilst an engine line ran from the Camden shed, outside the down fast line, to between the up fast and down slow lines.

Except the down fast line, all these lines have now been altered in position. Access to the down electric line is given from the down Euston slow and the down North London and from the up electric to the up Euston slow and the up North London. In addition to providing these



SECTION THROUGH THE CHALK FARM WIDENING

facilities advantage has been taken of the work to remove the crossing on the level of the up fast across the down and up slow lines in order to get to the arrival side at Euston Station, and, similarly, to pass the empty carriage trains which come from the carriage sheds at Willesden on to the down side of the line without fouling the down slow, up fast, and down fast lines.

To understand the direction taken by the various lines, the above view and cross section will be useful. The down fast line is numbered 1. The engine line is 2, and leads to buffer stops between the two original tunnels. Line 3 is the down Euston electric. In order to pass under the up fast line the down slow falls about 1 in 70, and so that the down Euston electric, after it has left the down slow, may pass under both slow lines, it falls 1 in 50 after leaving the down slow. Line 4 is the up fast, to which no further reference is necessary. Line 5 is for engines between the engine siding and all the lines on the north side of the up fast line, and passes over the intervening lines by the same bridge as the up fast line. Line 6 is the down slow, which, after passing under the bridge just named, rises 1 in 60 and enters the slow lines' tunnels at about its old level,

passing meantime over the down Euston electric. Line 7 is the up slow line, which keeps on the same levels as the down slow. Under the up fast line overbridge the up slow line is joined by the up Euston electric—line 8. The junction in the new up electric line that divides the up Euston electric and the up North London electric is in the northernmost tunnel and protected by light signals. It leaves the tunnel at a much lower level than the adjacent lines in order to pass under the lines that go into the slow lines tunnel. It then rises 1 in 40. Lines, 9, 10, 11, and 12 are goods lines, and call for no comment. Line 13 is the down North London electric. It leaves the down North London line on the Primrose Hill side of Regent's Park-road bridge. It has to pass under six other roads before it makes a junction with the down Euston electric, and so has a falling gradient of 1 in 29. Lines 14, 15 are the down and up North London lines which join the down and up slow lines respectively at the eastern portal of the slow lines tunnel. Line 16 is the up North London electric, which, like the up Euston electric, is at a low level in the up electric line tunnel, and, after passing under six lines, rises 1 in 44 and joins the up North London steam line on the west side of Regent's Park-road bridge. Line 17 is the up empty carriage line which, after leaving the up North London steam line, falls 1 in 44 and passes in a covered way under all the lines and emerges outside the down fast line at a point beyond the engine shed.

It will be remembered that the Ministry of Munitions intervened and caused the work to be stopped in 1917. Up to that time the contractors had been Walter Scott and Middleton, Limited. When the work was resumed the contract was let to John Cochrane and Sons, Limited, 39, Victoria-street, S.W. 1.

Electrical Power and Rolling Stock.

The power-house is situated on the north side of the up electric line at Stonebridge Park. Together with the carriage sheds, it occupies 17 acres. There are eleven sub-stations, one of which is in the power-house. They convert the 11,000 volts three-phase 25 cycles alternating current to 630 volts direct current for the conductor rails.

The motor coaches are fitted with four motors of 260 horse-power each. A train of two motor cars and four trailer cars weighs 224 tons and seats 326 persons. The rolling stock was built to the design of Mr. A. R. Trevithick, whilst Mr. F. A. Cortez-Leigh was responsible for their electrical equipment, as well as for the power-houses, the transmission, and the electrical installations generally.

To Mr. E. C. Trench must be given the credit for the successful solution of the engineering problems at Chalk Farm and for the design and execution of the works on the whole scheme. In this he was assisted by Mr. R. E. S. Cooper, the new works engineer. Mr. A. W. Donaldson has been the resident engineer for the Chalk Farm section. It only remains to be added that Colonel Pringle made his final inspection on behalf of the Ministry of Transport on Wednesday, the 5th instant, and that, on the invitation of Mr. L. W. Horne, the general superintendent, Southern Division, we were permitted, on Friday last, to ride over the line and to see the completion of a scheme which will give better travelling facilities to a charming suburban area.

The Society of Chemical Industry.

THE annual meeting of the Society of Chemical Industry, which was held in Glasgow from July 4th to 11th, emphasised the great advances that are being made in this country in the domain of chemical engineering and the growing appreciation of the importance of chemistry to our industries. It was the fourth occasion on which the Society held an annual meeting in Glasgow, and special interest attached to it, inasmuch as it was also the occasion of the first visit to this country of the president of the Society, Dr. R. F. Ruttan, Professor of Chemistry at the McGill University, Montreal. The election of Dr. Ruttan took place on the occasion of the visit of the Society to Canada last year.

Dealing with the various items of the meeting in the order in which they occurred, it is to be noted that the finances of the Society are now in a sound condition, a balance of some £3000 being shown for the year, a very different state of affairs from that which obtained a few years ago. At the same time, there is a decrease in the membership for the year, which is attributed to the bad condition of trade. The new president is Dr. E. F. Armstrong, of Warrington, who has been associated with the industrial side of chemistry for many years.

Dr. R. F. Ruttan, in his presidential address, chose as the main topic the question of scientific and industrial research, and, recognising that that is a well-worn subject, did his best to deal with it from a more or less new aspect. He outlined the attempts that are being made in the Colonies to organise scientific and industrial research. He laid it down as essential that expenditure upon research, both scientific and industrial, by the State should be accepted as one of the usual national responsibilities, and he suggested that only by the establishment of central research institutes by the various Governments would research be placed in its proper place. He asked what the position would be when the period of the Government guarantee to the industrial research associations in this country expired. Would the work of these associations then be continued along the lines upon which they had been started? He inferred that they would not, and that many problems of a border-line character between the industrial and the academic, now being undertaken, would be thrown over in order that greater attention might be paid to more utilitarian problems from which commercial results might be expected to flow in a relatively short time. If that were so, then many problems of vital national interest would be laid aside and only by the establishment of central research institutes by the Government of the country could those particular problems be investigated.

Another proposition put forward in the address was the establishment of an international parliament of science composed of representatives of all the civilised nations. Such an event, he held, would have greater international results than the present League of Nations, inasmuch as it would be free from politics. A beginning had been made in the International Research Council, established in Brussels in 1919, and the second meeting of which was called for the present month, also in Brussels. At the moment that International Research Council consisted of representatives of all the Allied and neutral nations, although there seemed to be some difference of opinion among the neutrals as to the policy of excluding the Central European nations. Dr. Ruttan suggested that finally it would be necessary to have representatives of all the nations of the world, if such a scheme was to be fully effective. The underlying principle of that scheme he epitomised as the universalism of science and the universality of truth. He also expressed the opinion that, although the industrial research associations had been criticised, they had done good work, inasmuch as they had led to the scrapping of the policy of industrial secrecy which had so greatly hampered the application of science to industry and was now almost obsolete. It had been proved that in most industries the policy of the closed door shut out more than it shut in.

Dr. E. F. Armstrong, in proposing a vote of thanks to the President, put it that such a scheme of central research institutes would involve bureaucratic control of research. If, he added, bureaucratic control is the best way to do research, all would be well. "I wonder," he concluded, somewhat significantly.

That closed the proceedings for Tuesday, July 4th. On the next day the first Messel memorial lecture was delivered by Professor H. E. Armstrong, F.R.S., whose son has been elected president of the Society for the coming year. The late Dr. Rudolph Messel left the sum of £20,000 to the Society, the whole of the income of which he directed should be applied in such manner as the Council thought most conducive to the furtherance of scientific research and such other scientific objects as the Council might determine. It has been decided to inaugurate a series of annual Messel lecturers and to award a gold medal to the lecturer. Professor Armstrong chose as the title of his lecture the rather alarming one of "Rhapsodies Culled from the Thionic Apos." The more serious part of it developed an argument that all chemical change is electrolytic, but in his well-known lighter vein, albeit stingingly critical, Professor Armstrong gave full vent to his artistry in that direction as regards several matters affecting the chemical industry. Critics of the Safeguarding of Industries Act will probably welcome his onslaught on the Referee under Part I. To use his own words:—"The need of care (in scientific expression) has been specially impressed upon us of late owing to the attitude adopted by the Official Referee of the Board of Trade appointed under the Safeguarding of Industries Act, 1921. Nothing could be more humiliating than the manner in which, sitting as a Delphic Oracle, this gentleman has created chaos in chemistry by his pronouncements upon our vocabulary." Later, still bearing on the Safeguarding of Industries Act, he said:—"Where is the cultured chemist to be found to-day? Recent hearings before the Board of Trade Referee have shown that witnesses—I will not call them chemists—were not even agreed as to what is a chemical. The innocent lawyer was trapped into the belief that it was something manufactured. Doubtless the definition was paid for—nothing else could explain and excuse its absurdity. All single things dealt with by chemists are chemicals. A chemical can only be defined as a material which can take part in a chemical change."

Another portion of the lecture was devoted to an enunciation of the necessity for chemists to be exact writers and critics. Too frequently the scientific writer was verbose and lacking in lucidity; mere tricks of speech pass muster which should be avoided. Unfortunately, Professor Armstrong continued, the pages of our chemical journals are full of examples of careless writing due to careless thinking, and the current rumour that a free-lance journal might be established in connection with the chemical societies was an augury for a happier future "if only the pedantry of a publication committee of superior, elderly intolerants, without imagination, can be avoided." Free exchange of opinion and free criticism among chemists was much needed, because the position of chemists in the world would depend upon the use made of our English tongue. We must learn, not only to weigh our words and use them effectively, but to use clean words, words that can be understood. At present we were overfond of using an affected attic terminology. The lecture concluded with the remark that, whilst claiming to be members of a scientific fraternity, chemists were not developing and using scientific method. "Let us recognise that chemistry is chemistry, one and indivisible; abolish sects and put pretence aside. By our proficiency we know that we are on the way to heaven as we know a tree is alive by its daily growth."

The annual dinner was held on the evening of July 5th, and the chief point of interest in the speeches was a plea by the President for steps to be taken to emancipate the chemists of the universities of the British Empire from the domination of German reference books. He urged that we should be in possession of English summaries of chemical literature of the last seven years at the earliest possible moment and so break the tradition of viewing chemistry "through German eyes." The almost exclusive use of German chemical compendia and monographs throughout the world had given that country a world-wide influence and prestige out of all proportion to the value of its contributions to knowledge.

On Thursday, July 6th, the Chemical Engineering Group of the Society held a conference, at which four papers were read on the general problem of evaporation and distillation. The first was by Mr. P. Parrish, who is in the chemical department of the South Metropolitan Gas Company, and was entitled "Observations on the Design and Working of Ammoniacal Liquor Stills." It was an attempt to bring us back to a true appreciation of the fundamental principles of the subject. The author pointed out that during the past fifty years hundreds of papers had been read on the subject, but they were all largely of a descriptive character and ignored the fundamental principles underlying the distillation of liquor. Most important among the points that had been ignored was the question of steam consumption, and attention seemed to have been directed by designers to providing stills which admitted of ready cleaning. The cost of cleaning, however, was an infinitesimal portion of the total cost, and much more important items were labour and steam consumption. In putting forward his views as to the direction in which progress in the design of ammoniacal liquor stills will be made in the future, the author said that designers must concentrate their attention and energies to the evolution of the elements of a still which will be economical as regards steam consumption. Data must be arrived at as to the relative value of attenuated bubbling as compared with time contact of the liquid and vapours as a factor in aiding equilibrium. Obviously distillation cannot proceed until the vapour pressure of the ammonia in solution in the trays is in excess of the vapour pressure of the ammonia in the vapours. The author is of opinion that such a bubbling device can be designed as will not only assist in promoting optimum bubbling and maximum impact between the respective series of bubbles so formed, but that such an arrangement need not necessarily reduce the factor of time contact of the liquid and vapour. As regards the utilisation of the surplus heat leaving the saturator, it is evident that the present arrangement of plant as generally known must be improved in order that more satisfactory conservation of the heat available can be ensured.

There was a good discussion on the paper in regard to matters of detail in ammoniacal liquor still construction and design.

The next paper was on "Tar Distilling," by Mr. W. A. Walmsley, who is in charge of the Provan chemical works of the Glasgow Corporation, and gave a description of the plant there. The Glasgow Corporation is the first large municipal body in the United Kingdom to work up its own gas residuals, and it now has four chemical works for the distillation of tar and ammonia, one at each gasworks. Just over three years ago, when the Corporation decided to work up its own gas residuals, three of these chemical works were leased to private contractors. These leases were terminated two years ago, and the works are now under the control of the chemical works department of the Gas Department. The Provan chemical works, which were visited by the members of the Society, are the largest of the four, the crude distillation of the tar being carried out at the other three works and the oils to be refined are transferred to Provan. There is a power plant, a sulphate of ammonia plant, a tar plant, and a causticising and carbolic extraction plant, as well as a benzol plant, a tar acid distillation and a naphtha stripping plant. Some interesting experimental work is being carried out at these works, which may eventually throw considerable light on some of the problems associated with high and low-temperature carbonisation products.

The third paper was read by Professor J. W. Hinchley, who was largely instrumental in securing the formation of the Chemical Engineering Group and it discussed the general problem of evaporation in chemical factories. He dealt with the subject to some extent mathematically and pointed out how the efficiency of chemical plant is capable of enormous improvement by the application of sound chemical engineering science. An increase in the supply of scientific and well-trained chemical engineers, he said, offers reward to the plant manufacturer and to the plant user, as well as an increase in national well-being. The guaranteed outputs of plant manufacturers are sometimes not one-half of the outputs possible under skilled management. The makers know that fact; but, realising how much they are dependent on the factories' superintendence, they dare not guarantee more than a good performance. The rate of heat transmission in evaporating plant from steam to water solutions might vary in the same kind of plant from 300 to over 3000 calories per square centimetre of surface per hour per 1 deg. Cent. temperature difference. That simple fact illustrated the possibilities of sound chemical engineering. The paper contained a number of equations bearing on the subject to which the students at the Imperial College of Science have now been working for some time.

The final paper at the conference gave a history of the development of glycerine manufacture.

A paper read by Dr. J. W. McDavid, after the Messel lecture on July 5th, explained a method for the calibration of storage tanks depending upon the principle that water flowing through a tube or orifice under a constant head gives a constant rate of flow. By calibrating the instrument with a particular nozzle, the rate of flow can be accurately determined, so that by observing the time taken to fill a tank to a given level the volume up to that level can readily be calculated. The apparatus weighs only 26 lb. and is therefore easily portable.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

AVOIDABLE WASTE IN LOCOMOTIVE OPERATION.

SIR,—May I again venture to intrude on your columns with a few remarks concerning "Avoidable Waste in Locomotive Operation," and especially regarding "C. R. K.'s" letter on pages 618–19 of your issue of June 2nd?

Mr. Partington does not say that the figures of 19.7 lb. steam per indicated horse-power-hour and 26.9 lb. coal per 1000 ton-miles were obtained at one and the same time. Nor does he say that the steam consumption was obtained from indicator tests. The fact is that 19.7 lb. steam per indicated horse-power hour is the assumed average rate used in making the basic calculations for the design of the locomotive. However, any engineer, with a profile of the Virginian Railway line between Princeton and Roanoke, Virginia, before him, can make a few arithmetical calculations which will show him that the two figures are not incompatible. A few particulars are added in a postscript.

"C. R. K." evidently does not understand that in this country it is the practice to run freight trains of the heaviest weight which the engine can possibly drag. Years of experience have shown this method of operation to be preferable to the European style of running the engines at their theoretical maximum efficiency with featherweight loads. Under such conditions it is not feasible to work the locomotive at a cut-off of 40 per cent., which he states is most economical for compound engines. The average running cut-off in the high-pressure cylinder of an American Mallet is nearer 60 to 75 per cent. of the piston stroke. No locomotive steam engine develops anywhere near its maximum horse-power at speeds of 10 to 20 miles per hour, and when this is combined with the further fact that the engine is working at a cut-off of 60 to 75 per cent. in the high-pressure cylinder, it is manifestly impossible to secure any such water rate as 13 lb.

per indicated horse-power hour. The Mallet is not designed for the development of great horse-power at high speeds, but is essentially a low-speed engine, developing great tractive effort at such speeds. It is therefore improper to compare results obtained from Mallet articulated compound engines with those secured from engines running in express passenger service. The fact remains that the Mallet has solved many of our heavy haulage problems, and all the prejudiced criticisms levelled at it from European sources will not change that fact one bit. The "Mallet" type is not used primarily because it is a compound, but simply because it is the only design to which can be built the large units necessary for goods traffic in America. As the type necessitates the use of four cylinders, one may as well secure any fuel and water saving that will result from compounding.

The advocates of compound locomotive engines seem to be obsessed with the notion that a saving in water and coal should ensure the immediate adoption of compounding, and do not consider the greater complication and consequent liability to failure and the much higher maintenance expense of the compound, which has caused it to be discarded nearly everywhere. In view of the excellent results obtained with the Woolf compounds in Russia in 1891, perhaps "C. R. K." can explain why all the Russian locomotives built in the years just preceding the Great War were *not* compounds; for example, all the standard types of the Russian State Railways, the 4–6–2 and 0–10–0 engines of the Vladikavkas Railway, and the 4–6–0, 0–8–0 and 2–8–0 types of the Moscow-Kazan Railway. It might also be mentioned that the 2–10–0 locomotives built in this country and in Canada for Russia during the war were simple engines, and the 0–10–0 locomotives, now being built in Germany and Sweden for the Soviet Government, are two-cylinder simples. This seems indeed singular.

It is hard to understand why the Paris, Lyons and Mediterranean continues to build superheater engines, in view of the fact, as stated in paragraph 5, page 619, that the saturated type is more economical.

Most engineers will realise that a great part of the economy realised from Mallet engines on the Pennsylvania division of the New York Central was due to the fact that the Mallets had Schmidt superheaters, while the Consolidations used saturated steam.

I would like to inquire when the "present general return to compound expansion in Germany" began. The P-8 (two-cylinder simple superheater 4–6–0) is the only locomotive class for passenger and express train services that is now being constructed for the former Prussian-Hessian State Railways. It is well known that the 2–10–0 three-cylinder "G-12" class of the Prussian State Railways has been chosen as the standard goods type of Germany, except Bavaria.

A few words in regard to the table on page 619 may not be out of place. The engine of the Hanover Machine Works at St. Louis, while running at 240 revolutions per minute and 30 per cent. cut-off, consumed 2.38 lb. coal per indicated horse-power hour. The Pennsylvania Decapods consume *less* than 2.9 lb. coal per indicated horse-power-hour at all powers below 3000, reaching a minimum of 2 lb. at 1750 indicated horse-power. The "extreme minimum" steam consumption recorded with the Pennsylvania Decapod is 14.9 lb. per indicated horse-power-hour, not 15.4 lb.

WM. T. HOECKER.

Galveston, Texas, June 22nd.

POSTSCRIPT.

Estimated Performance of Virginian Railway 2–10–10–2 Mallet Locomotive on 1 in 500 Ascending Gradient at 10 Miles per Hour with 15,725 Tons (U.S.) Trailing Load. Weight of Engine and Tender, 450 Tons (U.S.).

Frictional resistance of cars taken at	3½ lb. per ton
Frictional resistance of engine and tender ..	20 lb. per ton
Resistance due to gravity	4 lb. per ton
Resistance cars, 7½ × 15,725	114,006 lb.
Resistance, engine and tender, 24 × 450 ..	10,800 lb.
Total tractive effort	124,806 lb.

$$\frac{124{,}806 \times 10}{375} = 3328 \text{ I.H.P. developed.}$$

3328 × 19.7 = 63,848 lb. steam consumed per hour.
Assuming an evaporation of 8 lb. water per pound of coal,

$$\frac{65{,}562}{8} = 8195 \text{ lb. coal burnt per hour.}$$

Ton-miles per hour = 16,175 × 10 = 161,750.

$$\frac{8195}{161.75} = 50.7 \text{ lb. coal per 1000 ton-miles.}$$

The figure of 26.9 lb. coal per 1000 ton-miles is the *average* result over a division 97.2 miles long, fully half of which is on falling gradients varying from 1 in 166 to 1 in 66. The remainder is on a long ascending gradient of 1 in 500 and a short rise of 1 in 166. It is also probable that the engines used less than the assumed amount of 19.7 lb. steam per indicated horse-power-hour in actual service on the ascending gradients. When it is considered that one-half of the ton-mileage of the test runs was made with a coal consumption of around 50 lb. per 1000 ton-miles, and the other half was made on sharply falling gradients with the use of probably very little coal at all, it will be seen that an average of 26.9 lb. for the entire division is not beyond the realms of probability. The suggested figure of 269 lb. coal per 1000 ton-miles is manifestly absurd when applied to a division having the gradient profile mentioned above.

CORROSION.

SIR,—In your leading article last week you referred to the question of the use of non-rusting alloy steels in bridges.

If the average length of life of steel bridges is to be increased there would seem to be only one alternative to the use of rustless steels, and that is to make real use of what knowledge we have of the means of preventing corrosion in ordinary steel.

As a general rule a bridge is condemned through corrosion, not because all its members have lost a serious amount of metal, but because at one or two places the loss of a comparatively small amount of metal has produced serious and irreparable weakness. This corrosion has always occurred because the metal has not been adequately protected. Adequate protection of steel can be obtained by means of a suitable covering—there are many on the market to choose from—properly applied to clean metal, so that there seems no fundamental reason why corrosion should be accepted as a normal state.

The difficulties are purely practical, and to overcome them is merely a matter of cost. First, the bridge and its setting must be designed by an engineer who is familiar with bridge maintenance and the conditions under which the bridge in question will exist. Secondly, the bridge when erected must be cleaned and painted under the most careful inspection. Thirdly, periodical examination and repairs to the protective covering must be made under conditions which will ensure absolutely satisfactory results. All this is something quite different from the work of the average inspector and painter, and it cannot be inexpensive.

Whether the longer life of the bridge is worth the greater expense in first cost and maintenance will depend upon circumstances, which cannot be discussed here.

In a case in which longer life is worth added cost, the question to be decided is whether rustless steel with high first cost, or ordinary steel with high annual maintenance cost, will give more satisfactory results in a life of over one hundred years?

Westminster, S.W. 1, July 11th. BRIDGE ENGINEER.

THE HYDRAUTOMAT.

SIR,—I am much interested in your description of the Allen hydrostatic pump. The principle of its action appears to me to be very similar to that described as Close's hydraulic apparatus in pages 27 and 145 of vol. 1 of *Nicholson's Journal*, 1802. On page 29 Close suggests an arrangement of cisterns one above another, similar to that shown on page 21 of the current number of your paper.

G. M. R.

Portmadoc, July 12th.

The Efficiency of Water Turbines.

(Contributed.)

OF recent years claims for very high efficiencies have been made in the performance of water turbines. In some cases a discrimination as between standards defining the real meaning of efficiency has not been exercised, whilst in other cases a full understanding of the laws of hydraulics has been absent.

In arriving at the efficiency of a water turbine installation, a distinction must be made between the efficiency of the plant and the efficiency of the water turbine. The efficiency of the plant may include all losses of energy up to any given point of delivery, such as the losses in trash rack, sluice gates, pipe entry, pipe friction and turbine, the point of delivery being defined as the brake horse-power on the turbine shaft.

The true measure of water horse-power supplied to the installation is a function of the measured discharge of water passing through the plant, and the measured total net head actually obtained during delivery of the brake horse-power between the still water in the head race above the trash rack and the still water surface in the tail-race after discharge from the draught tube. As a general rule, the water turbine and its accessories are not purchased from a manufacturer responsible for either the design, supply or erection of the headworks, pipe line or tail-race. It is necessary therefore to confine the specifications and guarantees of efficiencies to those of the water turbine only, and to eliminate therefrom any consideration of forebay or pipe line efficiencies.

The quantity of water flowing through a turbine can be measured in a variety of ways. It may be assumed that the purchaser and the manufacturer can agree as to the means of measurement. It often occurs that measurement is only cheap and convenient by some method or by dimensions of weir to which standard formulæ of discharge are not applicable with a reasonable degree of accuracy. For this reason, turbine manufacturers generally guarantee efficiencies with a percentage toleration. If the method of measurement be decided and agreed upon by purchaser and manufacturer beforehand, there should be no necessity for any toleration in a guarantee—provided that the tests are taken by experienced observers and that the instruments used are precise.

When it comes to the determination of the total net head actuating the turbine, there exists a considerable divergence in standard and in specifications. The total net head may be defined as the sum of the pressure, kinetic and draught heads measured at the turbine entry. In a cased reaction turbine, the pressure head is observed on a calibrated pressure gauge connected to the entry pipe at a point where the diameter of such pipe has been accurately measured.

There should be no projection of the gauge connecting pipe into the entry pipe, or any setting of the connection which will cause the velocity of the water in the entry pipe to interfere with a true calibration of the pressure head. The head so observed is a measurement at the elevation of the centre of the gauge, of the actual pressure in the entry pipe. Any friction losses in the turbine casing, &c., must be debited against the machine itself.

The kinetic head is the head equivalent to the velocity in the turbine entry pipe at the point where and at the time when the pressure head was observed. The value of this head is equal to—

$$\frac{V^2}{2g} = \frac{8Q^2}{g\pi^2 d^4}$$

where Q = measured discharge through the turbine and d = diameter of the entry pipe.

The draught head can be measured directly, and is the difference in elevation between the centre of the calibrated pressure gauge and the water level of the surface of the tail-race immediately at the draught tube outlet.

In open pit turbines the pressure head and draught head can be observed in one measurement, viz., the difference in elevation between the water levels of the water surfaces in the head water directly over the turbine, and in the tail-race immediately at the draught tube outlet. In such a setting there is no kinetic head to be taken into account.

In impulse wheels there is no draught head, and the calibrated pressure head should be measured so that the centre of the gauge is level with the centre of the jet outlet. The kinetic head is computed as already explained.

The summation of the above heads being equal to H, the water horse-power =

$$\frac{62.4\ Q\ H}{550} = \frac{Q\ H}{8.8} \text{ (approx.),}$$

where Q = cubic feet per second and H = feet.

The above is the standard European method of measuring the water horse-power delivered to a turbine.

The standard American method differs from the European, in that when measuring the draught head a credit to the turbine is allowed to the extent of the head equivalent to the residual velocity in the draught tube outlet. Thus, supposing the discharge at the latter point to be 4ft. per second, the velocity head $= \frac{V^2}{2g}$ will be 0.25ft.

On a high head this would be negligible, but on a low head the results may be considerable. With a 10ft. total net head, as measured by the European method, the American method permits of only 9.75ft., a difference of 2.5 per cent. The water horse-power being proportional to the head, the result is that there is an apparent increase of 2.5 per cent. in efficiency.

Obviously, a comparison of efficiencies when the different methods of measuring are not taken into account places European guarantees at a disadvantage. Apart altogether from standard methods, a few instances have occurred where the inclusion of the kinetic head has been wholly omitted in computing the total net head. This has been due either to ignorance on the part of the purchaser or willing neglect on the part of the manufacturer.

A knowledge of the methods employed in measuring the total net head is absolutely necessary before accepting the results of some of the tests applied to plants now running for which high efficiencies are claimed. The writer knows of cases where the pressure head has been measured at the top of the spiral casing of a turbine, the kinetic head neglected altogether, and the draught head measured from the centre of the horizontal runner shaft to the surface of the tail-race. In such a case the difference in level between the shaft and the pressure gauge was 4ft., whilst an estimate of the kinetic head was at least 1.5ft., making a total of 5.5ft. on a total head of 100ft. The purchaser was contented that his turbine was delivering at 84 per cent. efficiency. In reality he was obtaining only 79.5 per cent., a figure which was below the manufacturer's guarantee of 80 per cent. In any case the methods of measurement were wrong. The total discharge was not passing at the top of the spiral casing, and the exact velocity could not be determined at that point, also the friction and possible eddies in the casing between the turbine entry and the point of measurement were excluded from the results. The probability is that the actual efficiency was lower than 79.5 per cent.

The decreased draught head permitted by the American standard would be understandable if the velocity in the tail-race continued the same as that of the outlet of the draught tube. In general, the area of the tail-race is much larger and the velocity less. At the point of measurement the residual velocity head is dissipated in the majority of cases. It is possible, however, that in confined tail-races there may be justification for a credit, but only in extreme cases could it amount to the full residual velocity head. The question of the measurement of the brake horse-power as on the turbine shaft, is not entered into at present. It can be observed directly by effecting a brake test, but in the majority of cases such a method will be impracticable. It is usual to measure the output by means of the electrical machines, allowing for their known efficiency.

In all cases the brake horse-power obtained is presumed to be a measure of the total output on the turbine shaft, and it should include any power used to drive the turbine governor, pumps or relief valves. The details make demands for power in order to regulate or safeguard portions of whole installations for which the turbine manufacturer is not responsible, and such demands should be credited to the turbine itself.

FOR some years past the aeroplane has been used in our Dominions for forest guard work, and some of the finest British Columbian timber has been saved from destruction by the watchfulness of the aerial patrol. More recently, according to the *Ironmonger*, the airman has been sowing grain; and at a flying speed of 80 miles per hour and a seven-hour day it is claimed that he can cover 1000 acres a day with seed. The sowing breadth is 9ft., and the seed is released from parallel tubes which can be placed at varying distances apart according to the desired pitch of "drill." The seed is projected with enough air pressure to bury it to the needed depth, and the pressure is increased or decreased according to the nature of the soil. One hundred men with one hundred teams of good horses would manage to do in a day about as much as it is claimed one airman can do.

A Seven-Day Journal.

Industrial Accidents.

THE annual report of the Chief Inspector of Factories and Workshops records a remarkable drop in the number of industrial accidents intimated to the Home Office during 1921. In 1920 the total number of such accidents amounted to 138,702, of which 1404 were fatal. The corresponding numbers last year were 92,565 and 951. Although, as the report points out, the provisions made to prevent industrial accidents, particularly in the cotton industry, are now bearing good fruit, the diminution last year, it is to be feared, is very largely, if not wholly, a reflection of the stagnation and dullness of trade rather than a sign of the improved efficacy of the safeguards in use. The coal strike, for instance, resulted in many large steel mills and blast-furnaces being closed down for a considerable period, and as such works are responsible for a heavy proportion of mishaps, this factor alone accounts for a good part of the great drop in the number of reported accidents. It is perhaps worth noticing that in both years the number of fatal accidents bore almost exactly the same ratio to the total number, namely, just over 1 per cent.

Proposed Engineering Exhibition in Glasgow.

THE proposal to hold another Shipbuilding, Engineering, and Allied Trades Exhibition in November at the Kelvin Hall, Glasgow, is not being very favourably received. A committee of the Glasgow Chamber of Commerce, asked by the Corporation for its views on the matter, has unanimously resolved to recommend that the exhibition should not be held this year. It arrived at this decision as a result of correspondence with a number of firms and associations likely to be interested in the holding of the exhibition. The replies showed much opposition to the proposal, and in some cases it was definitely stated that the firms would not exhibit in the event of the scheme being carried out.

Low Temperature Carbonisation.

IN a report circulated to the shareholders by the directors of Low Temperature Carbonisation, Limited, it is stated that the twenty retorts at Barnsley have now been running for nearly a year and are turning out with high efficiency smokeless fuel—"coalite"—and crude oil—"coaline"—from coal slack. It is recorded that a good demand at satisfactory prices exists for the "coalite" produced, the fuel being sold to about 2200 customers at prices in excess of those realised for best domestic coal. As farther evidence of the value of the fuel, it is stated that a leading coal distributor has signed a contract with the company to purchase the whole output of "coalite" for the next five years up to 250,000 tons per annum at the price prevailing for best domestic coal. As regards the crude oil, "coaline," the circular records that the whole output of the Barnsley works has been sold at 1s. per gallon, and that the purchasers are willing to take at least 200,000 gallons at this price. The crude oil has been found to yield on distillation ten gallons of motor spirit per ton of coal slack carbonised. Altogether the balance sheet shows a works profit of 13s. 2d. per ton of slack. This figure does not make any allowance for the value of the surplus gas produced at the retorts—an item from which, on development, considerable additional returns is expected.

Oil Fuel Station at Jarrow.

THE River Tyne Commissioners having completed the construction of the jetty and finished the necessary dredging work, the large oil fuel station at Jarrow, begun about a year ago by the Shell-Mex and the British Petroleum Companies, is now ready for use. Four vessels with tonnages running up to 9000 have already discharged oil in bulk at the station, so that ships requiring oil for bunkering can now be expeditiously dealt with. For some time past vessels discharging and loading oil have been accommodated by means of pipes stretching from the shore, but with the completion of the jetty and the dredging operations the work can now be conducted with much greater ease and speed. The station covers an area of eight acres and has six large reservoirs, four of which hold 8000 tons of oil each.

The Short "Silver Streak" Aeroplane.

IT has been known for a long time that the Short "Silver Streak" all-metal aeroplane exhibited at Olympia in 1920—see our issue of July 16th of that year—had been purchased by the Government and was being, or had been, subjected to tests. The nature of these tests and the results obtained were, however, never officially disclosed, although something more than a rumour reached us a considerable time ago that the machine had proved thoroughly successful in the air, and had withstood in a completely satisfactory manner very severe constructional tests to which it was subjected at Farnborough. In view of these statements it is difficult to appreciate the significance of the answer given by the Secretary for Air in the House of Commons on Monday, in reply to a question regarding the Air Ministry's attitude toward the machine. According to Captain Guest, doubt was felt as to the strength and trustworthiness of the material used in the construction of the machine—aluminium, duralumin, and steel—so much so that it was not considered desirable to put the machine through full air tests. Permission was, however, given to an experimental pilot to fly it "without load and without unnecessary manœuvres." The behaviour of the machine during this test was reported as being "favourable." The curious part of Captain Guest's reply is, however, contained in the statement that during the past eighteen months or so the Government has in its dealings with the machine been chiefly engaged in determining the resistance of its materials to corrosion.

A New Form of Rudder.

ACCORDING to the *Journal of Commerce*, a new form of rudder, the invention of a German, Anton Flettner, is being fitted to an 8000-ton motor ship now being built at Hamburg for the Hamburg-America line. The Flettner rudder has already been used with, it is said, marked success on a few small craft not above trawler size. It consists of a double rudder, one portion of which rotates about the forward edge in the usual way, while the other is hinged to rotate about the sternward edge of the first or main portion. To turn the ship to port the auxiliary rudder is moved to starboard, with the result that the water pressure on the auxiliary portion moves the main portion to port. It is claimed for the device that it greatly reduces the effort required to move the rudder and hold it in a deflected position, and that, as a consequence, it permits a reduction to be made in the size of the steering engines.

Port of London Improvements.

THE Bill promoted by the Port of London Authority and the Midland Railway under which power is sought to carry out certain improvements at Tilbury came before a Select Committee of the House of Lords on Tuesday. The works in view include, as stated in the Journal for April 28th, a floating landing stage 2000ft. in length and 80ft. wide, at which, if necessary, three liners could simultaneously berth. The stage would avoid the present necessity of discharging passengers by tenders. The total estimated cost of the complete works covered by the Bill is £956,000.

The Institution of Chemical Engineers.

THE proposal to form an Institution of Chemical Engineers has now reached an advanced stage, so much so, indeed, that forms of application for membership and associate membership are being issued. To meet the wishes of the Institute of Chemistry a definition of the term "chemical engineer" has been agreed upon. According to this definition a chemical engineer is a professional man experienced in the design, construction, and operation of plant in which materials undergo chemical or physical change. The definition is certainly very broadly drawn, for it clearly includes many people, such as boilermakers and kitchen range manufacturers, who probably have never for a moment regarded themselves as chemical engineers. But in the circumstances it will no doubt serve its prime purpose, which, we take it, is to distinguish between the chemist and the chemical engineer. The chairman of the Institution's Provisional Committee is Sir Arthur Duckham, and the honorary secretary, Professor J. W. Hinchley, 166, Piccadilly, London, W.

The Leader Cable and Merchant Ships.

FOR the first time a merchant vessel, the Royal Mail Steam Packet Company's Orbita, has used the Admiralty's leader cable running from Portsmouth to about 20 miles out to sea. The vessel made use of this aid to navigation whilst on her homeward voyage from New York to Hamburg *vid* Southampton. The Orbita, we believe, is the only British mercantile vessel so far fitted with the necessary electrical instruments employed in connection with the leader cable.

London's Air Defences.

THE Secretary for War, in the course of a Parliamentary reply, has revealed the fact that the War Office is forming two Air Defence Brigades numbering together 3266 of all ranks for the ground defence of London against hostile aircraft, and as a beginning of a complete organisation for the aerial defence of the whole country. The London brigades will co-operate with one or more squadrons of the Royal Air Force. They will be recruited on a territorial basis, and will involve an annual expenditure of £110,000. It would appear that deep consideration is still being given to the problem of determining to what extent our air defences should be on the ground or in the air. How far our means of defence against hostile aircraft have been improved since the Armistice we are unaware, but it is certain that in spite of the impressive nature of our defences in the latter days of the war, the system arrived at left much room for improvement in the way of efficiency and economy. It is understood that the ground defence force will place chief reliance on the 3in. gun as used towards the end against the war-time raiders.

Manchester's New Oil Dock.

WITH the official opening, at the end of last week, of the Stanlow oil dock on the Manchester Ship Canal, near Ellesmere Port, the Manchester area has received an important addition to its commercial facilities. The new dock is intended primarily for the discharge of steamers carrying petroleum, lubricating, illuminating and fuel oils. It has a length of 600ft., a width of 100ft., and a depth of 30ft., and is carried out in reinforced concrete, including a caisson designed to close the entrance in the event of a fire, so as to prevent burning oil from entering the canal. The oil is discharged by the ships' pumps into one or other of three steel pipes, which, passing through a 6ft. tunnel beneath the canal, deliver the oil to the oil companies' holders on the opposite bank. At a distance of a hundred yards from the dock a steam generating station has been erected to supply superheated steam to the oil-carrying vessels, so that their pumps may be run while their fires are out, as required by the regulations. A steamer carrying 3000 tons of oil has already been discharged at the dock in about twelve hours. At present only refined oil is to be handled at the dock, but later on refineries may be erected as at Swansea.

Labour Trouble at the New Barton Station.

A LABOUR dispute of something more than local interest has arisen at the new generating station at Barton, now being built for the Manchester Corporation. About a hundred building trade operatives employed on the works have been on strike for some time on the ground that they have considerable distances to travel each day, and that the contractors refuse to pay them the 9s. per week agreed to be allowed by the Building Employers' Association to men engaged on work situated above a certain distance from their homes. The contractors, however, state that they are not members of the Building Employers' Association, but of the Civil Engineering Association, and that therefore they are not bound by the agreement. The workmen's representatives have now turned to the Corporation and asked it to insist upon the "fair wages" clause in its contract being put into operation; otherwise, the whole of the Corporation's Electricity Department may become involved in the trouble.

The New Battleships.

THE Admiralty, according to the First Lord, Lord Lee, intends to proceed with the construction of the two new capital ships permitted to this country under the Washington agreement. There are no new developments either in aerial or submarine methods of attack which are held to necessitate a reversal of the decision to build. The battleships will cost six and a half million sterling each, or eight million with all accessories. A saving will be effected by scrapping four existing capital ships the places of which will be taken by the two new vessels.

The Cost of Aeronautical Research.

THE report of the Aeronautical Research Committee for the year 1921–22 lays considerable stress on the restrictions imposed upon vital investigations connected with aeronautics by the demand for a reduction of Government expenditure. Various means have been adopted to reduce the expense incurred in this department of research, but we are glad to observe that so far as the volume and nature of the actual research work undertaken is concerned, the measures adopted have apparently had little effect, the reduction of expenditure being secured mainly on the administrative side. The Committee records that the whole of the research work supervised by it costs only about 1 per cent. of the vote for the Royal Air Force and the Air Ministry. Had the airship R 38 been a success, it adds, the money received by its sale would have financed the Committee's full activities for a period of five years. If the work of the Committee led to a reduction by one of the aeroplanes written off annually as a result of crashes it would have earned the cost to the Air Ministry of the fees paid to its members,

The Royal Show at Cambridge.

No. II.*

QUITE the most predominant feature of the implement section this year was the large number of exhibits of small self-contained electric lighting sets, operated by petrol and paraffin engines. Considering the amount of very highly skilled labour which is required in the construction of these appliances, and the still high cost of this kind of labour, the prices charged are remarkably reasonable. For the owners of country houses and farms who have hitherto had to depend for artificial light upon oil lamps and candles, these generating sets should be a boon. The expenditure of about £150 is sufficient to purchase the complete equipment, including engine, dynamo, switchboard and accumulators, for a house with thirty lights. Most of the British-made sets are extremely compact and silent in operation, and in the latter respect are far and away ahead of most of the imported sets. There is a growing tendency to mount the dynamo on an extension of the crank shaft of an air-cooled high-speed engine, the fly-wheel of which acts as a fan to induce a current of air to flow round the cylinder walls. The switchboard is frequently mounted upon the dynamo casing. In some cases the generator is constructed to act either as a dynamo or as a motor, so that the engine can be started automatically when the accumulators require charging, but this is a luxury that can be dispensed with if a generous accumulator capacity is provided. The makers of these small lighting sets are Corbett, Williams and Son, Rhuddlan; Capel and Co., Dalston-lane, London; Bamfords, Limited, Uttoxeter; Belliss and Morcom; Birmingham; R. A. Lister and Co., Limited, Dursley, the Wolseley Sheep Shearing Machine Company, Birmingham; Petters Limited, Yeovil; Boulton and Paul, Limited, Norwich; Sims and Sims, Stanhope-terrace, Gloucester Gate, N.W. 1; Sir W. G. Armstrong, Whitworth and Co., Limited; F. S. Bennett, Limited, Orchard-street, London; and Fairbanks, Morse and Co., Limited, Southwark-street, London.

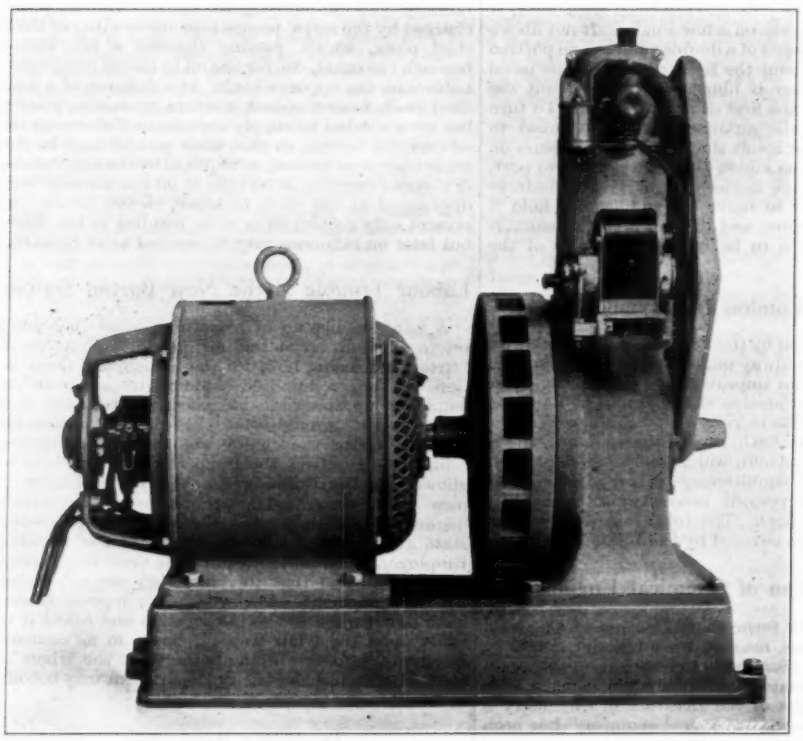
In addition to its well-known petrol tractor, the Austin Motor Company, Limited, Birmingham, showed a new 2-kilowatt automatic lighting set—Fig. 20, p. 40—and the portable electric power plant shown in Fig. 21. Small electricity generating sets are broadly divisible into two categories, first, the high-speed direct-coupled sets, and secondly, low-speed direct-coupled or belt-driven sets; but the Austin firm has adopted an intermediate design. Then there are the hand-controlled, semi-automatic and full automatic sets. The first is becoming obsolete, and is being replaced by the semi-automatic type, which in turn will probably give way to the full automatic units of which there are already several on the market. The Austin set is fully automatic. The engine is of the vertical, four-cycle, enclosed type, with two cylinders, 3in. diameter by 3½in. stroke, and water cooled. The pistons are of cast iron, with rings of similar metal, and the gudgeon pins are hardened and ground. The crank shaft is machined from a solid nickel-chrome steel forging, the wearing parts being ground and polished. The cam shafts are machined in one piece from the solid, and the cams hardened and ground. The tappets are easily accessible and adjustable. The main bearings are of gun-metal, lined with white metal. Forced feed lubrication is fitted, the oil being drawn through a filter from a large reservoir in the base of the engine. The pressure is adjustable, an oil gauge being provided to indicate it. The fly-wheel is of the solid web type, and is fitted on a cone on the crank shaft. The governor is of the centrifugal type. It runs at engine speed, and there is a throttle on the induction pipe. For petrol engines a jet carburetter only is fitted, but for paraffin engines there is an additional vaporiser, the change over from petrol to paraffin being automatic. For towns gas a suitable mixing valve is provided. When petrol is used, one tank only is supplied, but for paraffin a small supply of petrol is contained in a separate tank. A gas pressure regulator is supplied in place of the fuel tank for plants running on towns gas. The ignition is by high-tension magneto. The dynamo is of the ventilated enclosed type, and is self-contained, with switch gear and controlling relay. It is compound wound, and has interpoles. The end shields are of cast iron. That at the engine end is provided with ventilating apertures, while that at the commutator end is provided with removable perforated covers, so as to allow access to the brush gear. The commutator end shield is extended to form the case for the automatic controlling switchgear. The armature is of the slotted drum type, former wound. The commutator is large enough to allow for "third" brush voltage regulation, which is a feature of the system. Carbon brushes are used, the brush holders being mounted on adjustable supports. Ball bearings are fitted at both ends of the shaft. The terminals are enclosed, but are instantly accessible. The switchgear is within an extension of the commutator end bracket, and is easily accessible by the removal of a large end cover. It is arranged so that the plant may be operated:—(*a*) As a fully automatic plant, *i.e.*, self-starting, self-stopping and self-regulating when controlled by the relay; (*b*) semi-automatic, *i.e.*, self-starting and self-regulating or self-stopping and self-regulating; (*c*) hand controlled, but self-regulating, hand-starting and hand-stopping, either by direct operation of the switchgear or by means of push buttons on the relay. The system of control is as follows:—When the battery requires charging, a two-way switch, magnetically or hand-controlled, connects the dynamo to the battery, and when it is fully charged, the dynamo is disconnected and the load is switched on to the battery. Push buttons are provided to allow these operations to be carried out at any time by hand, and the special windings on the machines regulate the voltage at the lighting terminals to compensate for the variations in load and state of charge of the battery. The controlling relay is mounted above the bracket and has incorporated in it a time element reverse current cut-out and indicator. An ammeter or volt-ammeter is provided to register the output, as are switches to control at will the automatic starting or stopping of the plant.

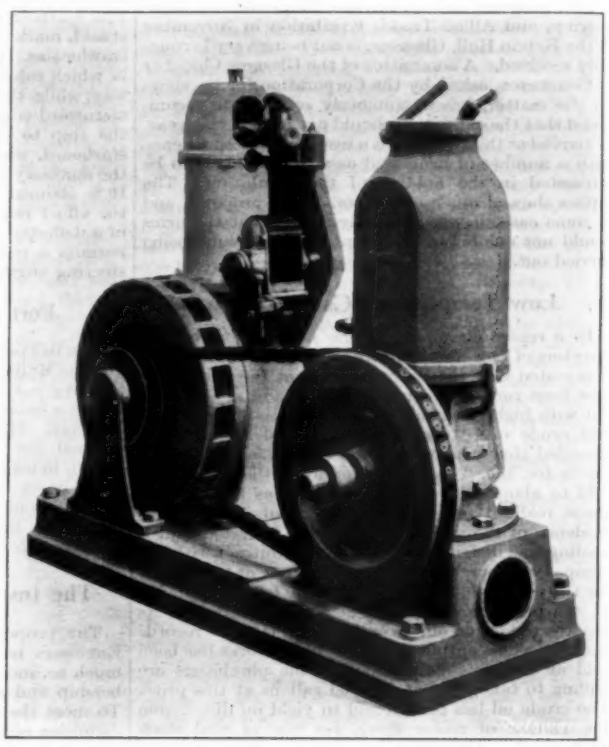
The Austin portable plant—Fig. 21—can be used for a variety of purposes besides generating electricity. In the illustration the set is provided with an automatically controlled dynamo, water tank, radiator, and with the necessary axles and wheels to render it portable. The engine cylinder has a bore of 3¾in. and a stroke of 5in. It develops 3 horse-power at 700 revolutions per minute. The connecting-rods are steel stampings. The cam shaft is driven by helical spur gear and the cams are solid with it. The lubrication is by means of a submerged gear pump, which takes oil from the base and forces it to the crank shaft and connecting-rod bearings. The piston is lubricated by means of the oily vapour in the crank chamber. The oil pressure is adjustable and shown on a gauge. The ignition is effected by magneto. A simple fully automatic carburetter is used; and it is claimed to render starting easy and running economical. The engine speed is controlled by an adjustable governor acting on the mixture control valve. Alternative methods of cooling can be employed. When the engine is used as a self-contained portable set, the circulating water is cooled by means of a radiator assisted by a centrifugal fan. A water circulating pump, driven from the same shaft as the magneto, can be attached when desirable. When the set is fixed permanently, water circulating tanks can be substituted for the radiator, or, when an ample constant supply of water is available, it may be coupled direct to the cylinder jacket. When the power plant is being used for driving a water pump, a small quantity of its supply can be diverted through the engine for cooling purposes. When used as a marine engine a small plunger pump is fitted.

Another very attractively designed small lighting set is the 1½-kilowatt Celtic built by Donald Brown and Co., Limited, Newcastle-on-Tyne. The motive power for this set is supplied by a vertical single-sleeve valve engine with a bore and stroke of 3in. and 3½in., the normal speed being 1000 revolutions per minute. The engine is air cooled, the incoming air being caused to circulate round the cylinder by means of a fly-wheel fan, the cylinder being covered by a cowl with an opening at the top for the admission of air The dynamo armature is mounted on an extension of the crank shaft, which runs on ball bearings. The dynamo is totally enclosed and the set is semi-automatic. It stops when the cells are fully charged, but is started up again by hand. There are sixteen cells, giving 32 volts, and the total capacity is 210 ampère-hours. The principal dimensions of the set are:—Overall height, 25½in.; width, 19½in.; length, 23½in.; and the weight, exclusive of the accumulators, 336 lb.

The recent engineering strike had the effect of materially reducing the exhibits on a number of the stands. The National Gas Engine Company, Limited, Ashton-under-Lyne, is only one of the firms which suffered in this respect. The engines shown were representative of the firm's horizontal and vertical single-cylinder types. A special feature of the stand was a producer working on the down-draught principle, which is capable of burning wood or any bituminous fuel. It supplied gas to drive a 5 brake horse-power horizontal engine and a combined set, which is illustrated in Fig. 22, is mounted on an undercarriage and wheels for portability. The plant is designed to burn the tar given off from the fuel, thus simplifying the scrubbing arrangements.

Another interesting exhibit was a 6 horse-power vertical engine operating on suction gas. It is shown





FIGS. 11 AND 12—MIRRLEES, BICKERTON AND DAY PARAFFIN ENGINES DRIVING DYNAMO AND AIR COMPRESSOR

* No. I. appeared July 7th.

in Fig. 23. The engine is, however, designed to operate with petrol, paraffin, town or suction gas, and a change over can be effected in a very short time. Two very simple paraffin engines made by Mirrlees, Bickerton and Day, Ltd., were exhibited on the National Gas Engine Company's stand, each of them being of 3½ brake horse-power. One was direct coupled to a dynamo and the other drove a small three-stage air compressor. The engines are shown in Figs. 11 and 12. The important feature of these engines is that, instead of having two valves per cylinder, viz., one exhaust and one inlet valve, there is only one valve, as shown in Fig. 13. This simplification is rendered possible by means of a rotating deflector. The engine works on the four-cycle system. The left-hand diagram shows the position of the valve and the deflector on the exhaust stroke, during which the exhaust gases pass out over the valve and are deflected into the exhaust pipe. Thus the valve and the deflector become heated during this period. In the centre diagram the action of the valve and deflector during the suction stroke is shown. The valve is still open, but the deflector has moved so as to lead the inlet gases to the cylinder, and in this way the valve and the deflector are cooled, the vaporisation of the paraffin being thus improved. In the right-hand diagram the valve is shown closed during the explosion stroke. The makers claim that any specks of carbon deposited on the valve face during the exhaust stroke are blown off by the incoming gases and that the valve will require less attention in consequence. It is also claimed that the shape of the combustion space is better than is possible with engines having two valves per cylinder. The cam operating the single valve is attached to the rotary deflector and the whole combination makes an exceedingly simple engine. The single valve being cooled by the incoming gases enables air cooling to be adopted for the cylinder, the air being drawn round the cylinder walls by means of the fly-wheel fan.

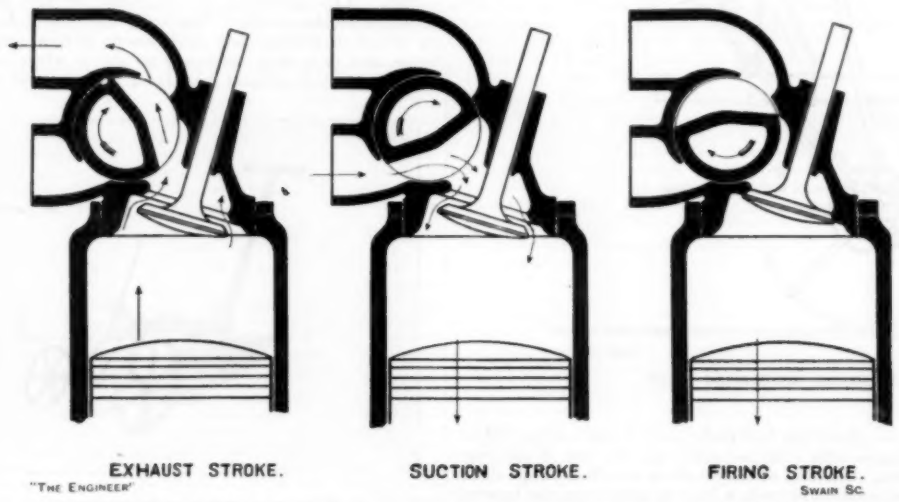


FIG. 13—DIAGRAMS SHOWING VALVE ACTION OF MIRRLEES, BICKERTON AND DAY'S PARAFFIN ENGINE

Besides the Glasgow tractor, the firm of Wallace (Glasgow), Limited, Cardonald, had on view a 6–8 horse-power horizontal single sleeve valve engine, and a 3 horse-power vertical single sleeve valve engine, of the air-cooled type, the latter, a view of which is given in Fig. 24, operating a 1¾-kilowatt lighting plant. The voltage is 110, and the speed of the engine 1000 revolutions per minute. These are four-stroke engines. The sleeve valve runs at half the engine speed, and has a natural lubricating and friction reducing motion produced by a compound movement. There is no sudden reversal of direction of travel to cause vibration. The air-cooling system in the small vertical engine consists of a cowl enclosing the cylinder and forming an air duct, through which air is drawn by means of a suction fan fly-wheel. The system is simple and efficient, and eliminates water tanks. This engine has a two-speed drive, one for driving the dynamo being obtained direct from the crank shaft, and the other, or half engine speed, being driven from the crank shaft by means of machine-cut helical gears. A feature of this engine is the detachable head, which has a machined compression space of hemispherical shape. Lubrication is by the splash system, and is adjustable, and the speed of the engine is controlled by a sensitive governor. The engine and dynamo—the latter by Cromptons—are mounted on a common bedplate, and the switchboard is carried on the dynamo.

A portable crane driven by a small oil engine was exhibited by Herbert Alexander and Co., Ltd., Leeds, The main features of this crane are its portability and its ease of control. A feature of the crane is that when not in use for lifting purposes, the engine runs free and its power may be utilised for driving other machines. It was shown at Cambridge, for instance, transmitting power to an electric motor and from the motor to a model brick-making machine. For lifting purposes the engine crank shaft is extended and carries a friction clutch and spur pinion, which engages with spur gearing operating a rope winch, and the clutch is operated in and out of gear by the attendant pulling a cord. By this means the clutch and brake on the drum shaft are put into and out of gear respectively, or *vice versâ*. The engine is one of Petter's make and runs on paraffin. The pillar which carries the jib runs on ball bearings, and can easily be swung round, and a knock-off device is provided which prevents overwinding of the load by pulling the cord out of the attendant's hand. A view of this crane is given in Fig. 25. The machine is provided with a manure grappler, which operates in the same manner as a hand digging fork and a sack grip which effectively secures either closed or open sacks, as shown in the illustration.

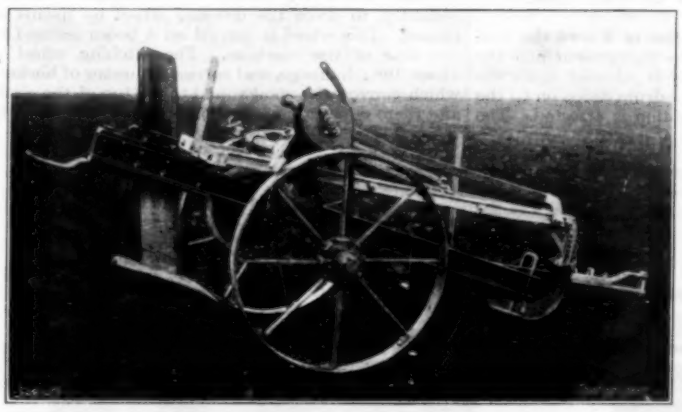


FIG. 14—THE MARTIN MOLE DRAINER

A feature of special interest on the stand of Martin's Cultivator Company, Limited, Stamford, was a new mole drainer or sub-soiler, an illustration of which is given in Fig. 14. This machine has been specially designed for use with a tractor as a one-man equipment. It can be used either on the flat or to work in a previously ploughed furrow. In the former case, it can be adjusted to work down to 18in. deep, and in the latter to 18in. plus the depth of furrow. The mole, which is made from 2¼in. diameter steel, case-hardened, and can be fitted with 2½in. or 2¾in. bore increasers or a sub-soil share, without changing the mole, is attached to a steel knife-edged coulter, set at the correct cutting angle so as to be easy to draw, adjustably mounted in the plough beam. This beam, which is built up from steel channels, does not run on the ground, but is carried by skids at the front and at the rear, the former being adjustable so as to vary the pitch of mole nose when required. A disc coulter runs in front of the knife coulter, to open the ground. The draught bar is hinged to the plough beam, and is provided at its forward end with a wood break pin. The main frame, with its chain-driven positive ratchet lifting gear, the cranked axle and the road wheels, are made up on the same lines as this firm's self-lift tractor cultivators, harrows and ploughs. This main frame is attached to and carries the plough beam by means of a joint pin bolt at the forward end, and at the rear end by a plate with a series of holes, which enables the machine to be set for working either on the flat or in a furrow. The machine is attached to the tractor by from 4ft. to 6ft. of chain, but the length of chain required depends entirely upon the height of the tractor draw-bar from ground, and the lift and fall are operated alternately by one pull of the cord.

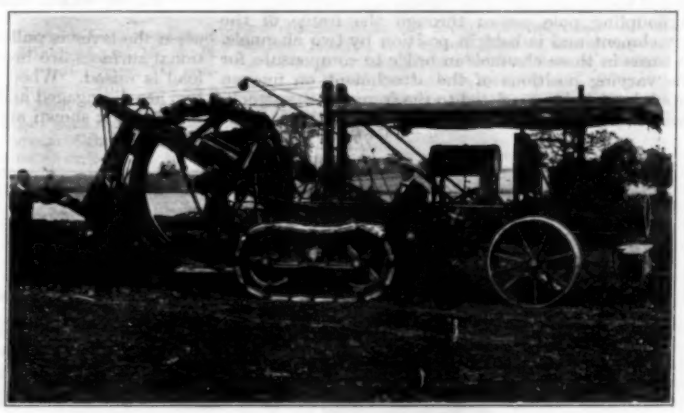


FIG. 15—THE BUCKEYE DRAINING MACHINE

The exhibits of Ruston and Hornsby, Limited, embraced nearly all branches of agricultural engineering. Thrashing machines, ploughs, chaff-cutting machines, centrifugal pumps, oil engines, traction engines, motor rollers, gas engines and producers of the most improved types were shown. Visitors who were specially interested in the utilisation of waste refuse for the generation of power had an opportunity of seeing wood refuse being utilised in this firm's producer. In this apparatus the general principle of gas generation is the same as in the case of the anthracite producer, and, in order to give a uniform draught through the fuel bed, it is fitted with multiple gas outlet pipes arranged around the top of the generator. On leaving the latter the gases enter the dust collector, passing down two outer tubes and up a centre one, where they meet a strong spray of water. The functions of the dust collector are to cool the gas and to precipitate dust coming over from the generator into the water seal beneath, from whence it can be readily removed. Tar is removed from the gas by centrifugal action in conjunction with water injection in a rotary tar extractor running at high speed, and is discharged into a settling pit below. Any tar in the gas after leaving the tar extractor is eliminated by filtration through dry beds of coarse sawdust in the scrubber, after leaving which the gas is fit for use in an engine. It is said to be somewhat richer than that obtained from anthracite or charcoal. The Ruston plant is fitted with scrapers to the main gas outlet pipes, by which the pipes can be cleaned whilst the producer is working. As a general practice the scrapers are pushed through the pipes twice a day. All the other parts of the producer are made so as to be readily accessible for cleaning. In cases in which it is uncertain as to whether there would be sufficient wood refuse or other waste material a vaporiser and air-lock fuel hopper can be fitted so as to enable the producer to work on anthracite, coke, or some kind of suitable semi-bituminous coal. Wood and other vegetable refuse requires neither a vaporiser nor an air-lock fuel hopper. Another feature of the Ruston and Hornsby stand which is deserving of special mention was a new deep-digging tractor plough which was entered for the Society's silver medal competition. It is a self-lifting plough, and the makers claim that it will plough to a depth of 15in. Two patented devices are incorporated in the machine. The first is in connection with the bridle or draught bar, while the second is concerned with the regulation of the depth of work and the mechanism for lifting out or dropping the plough into work. It has hitherto been customary to obtain alignment of plough and tractor by alteration of bolts and nuts, an operation which takes up a considerable amount of time. With this new design it is simply necessary to turn a cranked handle on the draught bar to bring the plough at once into alignment with the tractor. Furthermore, on hillsides the plough can be kept up into its work by altering the angle of draught. The other improve-

ment deals with the raising of the implement when coming to a headland and the lowering of it again. A simple arrangement of ratchets and pawls worked in conjunction with a spring locking bolt operated by a cord either lifts the plough out of the ground or drops it into work. The action is positive, simple and fool-proof. The sketch Fig. 16 illustrates how the depth of work is regulated by the rod E connecting the land wheel axle to block B, which is operated by a screw attached thereto and moves along the horizontal bar C.

The British Wallis tractor shown by Ruston and

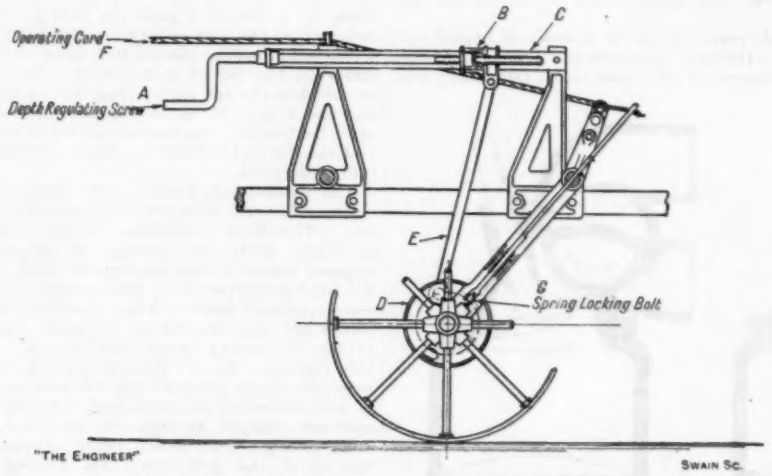


FIG. 16—RUSTON AND HORNSBY—PLOUGH SHARE REGULATING GEAR

Hornsby, Limited, is well known to agriculturists. The engine is of the slow-speed type, designed to run on paraffin, develops 28 horse-power, and has ample power to meet the demands of rough ground. The cylinder head is detachable, the crank shaft is of the three-bearing type with extra large bearing surfaces, and oiling is effected by a plunger pump. A high-tension magneto with impulse starter is provided for ignition. The water circulation is produced by means of a centrifugal pump, and there is a hydraulic type governor.

Ransomes, Sims and Jefferies, Limited, Ipswich, showed a lorry conversion attachment, which is being made in three sizes, the two smaller for use in conjunction with petrol lorries, and the largest for use behind steam wagons. We give an illustration of the last in Fig. 17. The employment of this attachment in conjunction with any four-wheeled steam or petrol lorry converts the latter into a flexible six-wheeler and increases the capacity nearly 100 per cent. It is claimed to be particularly suitable for bulky loads, and as its wheels run in exactly the same track as the driving wheels of the leading vehicle, the combination can be hauled round any sharp corners that can be turned by any ordinary four-wheel lorry. The attachment is flexibly fitted to the rear end of the motor vehicle by means of a universal joint. A coupling pole passes through the frame of the attachment and is held in position by two channels. It turns in these channels in order to compensate for the varying positions of the attachment on uneven ground. A bolster is fitted to the frame of the attachment. This bolster, to which the rear portion of the

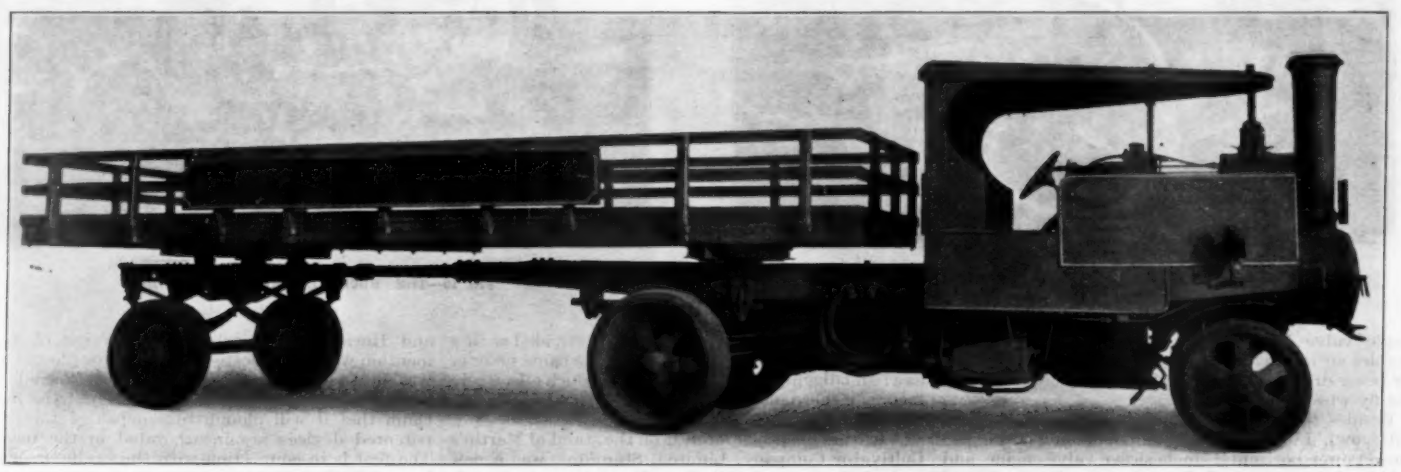


FIG. 17—RANSOMES, SIMS AND JEFFERIES—LORRY CONVERSION ATTACHMENT

body is attached, is provided with a small turntable, enabling it to swivel and tilt so that neither the body nor load is distorted by the turning of the attachment. When a load is mounted on the combination body, the conversion attachment will follow in the track of the prime mover without disturbing the load, since any relative movement of the forward bolster and

motor vehicle will be compensated by the bolster on the sliding saddle, which is both pivoted and tilted.

One of the many appliances entered for the competition for the Royal Agricultural Society's silver medals was a simple sack hoist made by the Hemel Hempsted Engineering Company, Limited, Hemel Hempsted. A view of this device is given in Fig. 18. It is capable of lifting a 3-cwt. load at a speed of 100ft. per minute with 1¼ belt horse-power. It is a very simple device and works by friction. The first motion shaft on the top is driven by a belt, and runs in fixed bearings in the side frames. On the end remote from the belt pulley is a friction drum, which engages with a large pulley on the end of the rope drum. One end of the shaft on which the rope drum is secured revolves in a fixed bearing, and the bearing at the other end is arranged excentrically, so that

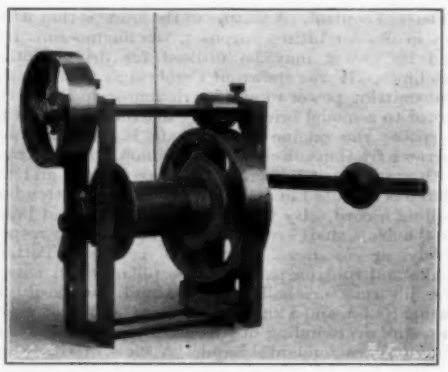


FIG. 18—HEMEL HEMPSTEAD CO.—SACK HOIST

when the lever is pulled by means of a cord the frictional surfaces are brought into engagement and the load is raised. When the lever is released again the two are disengaged and the rope drum drops on to the brake block shown and the motion is arrested. The machine is so designed that it can be fixed either vertically or horizontally, and the leverage is so large that only a slight pull on the cord is necessary to set the hoist in motion.

The awarding of the Society's silver medals for implements is always an invidious task, and one which is open to a considerable amount of criticism. This year the judges must have had more difficulty than usual in coming to a decision, owing to the large number of competitors and the great variety of inventions. Few would, however, question their decision in awarding one of the medals to Motes, Limited, Palace Chambers, Westminster, for a simple and inexpensive device called the Titan "hortiplow"—Fig. 19—which can be operated by even a child, and it is claimed that with its aid one person can do the work that has hitherto required a man and horse. The plough is propelled by moving a handle backwards and forwards, and this movement causes a steel cable anchored at the far end of the land which is being ploughed to be wound upon a drum fitted behind the breast, and thus pulling the plough through the ground. The depth of the furrow is controlled by a movement of the lever shown in the fore part of the machine. This lever adjusts both the travelling wheels at the same time to any depth up to 9in. The direction is controlled by the lever attached to the coulter. Normally the plough keeps its direction without any adjustment of this coulter lever, and it is only necessary to use it when some obstacle in the ground has been encountered and

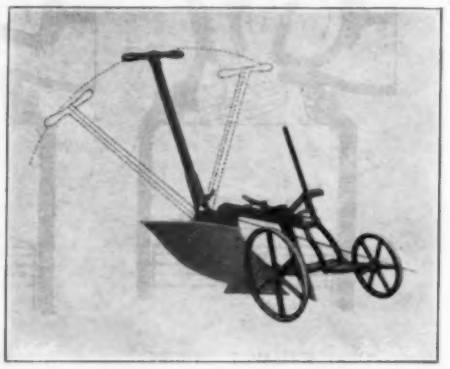


FIG. 19—THE TITAN "HORTIPLOW"

thrown the plough out of the straight. A slight turn of the lever to the right or left will quickly correct the deviation. The method of anchoring the cable is simple, and easily effected:—Two stakes are driven into the ground at the edge of the land to be ploughed at a distance of 10ft. to 12ft. apart, and behind each of these stakes is placed a piece of timber or rail. The hook at the end of the cable is then secured to the timber or rail.

Sir Douglas Newton, of St. Neots, Huntingdon, exhibited in the new implement section a draining machine manufactured by the Buckeye Traction Ditcher Company, Findlay, Ohio. This machine is designed to cut drains in one operation up to 5ft. 6in. deep and from 11½in. to 14½in. wide. It grades the trench when cutting it irrespectively of the contour of the surface of the land. It is a rather complicated piece of mechanism, comprising a main frame which carries a paraffin engine, the power of which can be utilised for several purposes, first, to propel the machine itself by means of caterpillar wheels; secondly, to drive the ditching wheel by means of chains. This wheel is carried on a boom secured in the rear of the machine. The ditching wheel is about 10ft. diameter, and carries a number of buckets which convey the spoil round to the top of the circle and there deposit it on to a band conveyor, which, in turn, deposits the spoil outside the trench. The power throughout is transmitted chiefly by chains, and the machine will under suitable conditions cut a trench at the rate from 6ft. to 12ft. per minute. A view of the machine in operation is given in Fig. 15.

Railway Matters.

As a sequel to the withdrawal by the North-Western–Midland group of railways of its Bill for powers for road transport, the West Scottish Group has withdrawn its corresponding Bill.

THE recent fatal accident to Sir John Rees evidently prompted the recent question as to the railway carriage doors, which led Mr. Arthur Neal to reply that he was advised that the use of automatic locks to hold doors until the train was at a stand would be liable to interfere with the egress of passengers in the event of accident or emergency. Such locks were also open to other practical objections.

THE next stage in the grouping of the Eastern and East Coast English and Scottish railways—the Hull and Barnsley having been disposed of—will probably be the amalgamation of the Great Central with the North-Eastern. This suggests, further, that the North-Eastern is taking the lead as to the eastern group, as has the London and North-Western with the North-Western-Midland and West Scottish.

COMMENCING on Monday last, the 10th instant, the Great Western Company put on two new long-distance non-stop trains. They are the 12 noon from Paddington to Kingswear, which runs to Torquay, 200 miles, in 3 h. 35 min., without a stop, and the corresponding up train from Kingswear, which leaves Torquay at 12.10 and runs to Paddington without a stop, being due there 3.45. Two additional two-hour trains run in each direction between Paddington and Birmingham.

AT the last meeting of the Institution of Railway Signal Engineers two papers, one by Mr. W. J. Sadler and one by Mr. H. E. Fawkes, on "Light Signals," were read. The discussion which followed made clear that the members of the Institution are not as sanguine as the Light Signal Committee, appointed by the Ministry of Transport, as to these signals being universally used instead of semaphore signals. The merits of the one-lens signal as against the multiple lens were very much discussed.

THE Mexican Government has given authority for the construction of a railway from Agua Prieta, in the State of Sonora, along the northern boundary of the Republic, to Guzman, in the State of Chihuahua. The distance is roughly 180 miles, and the cost is estimated at 6,500,000 pesos, approximately £650,000. The construction, which will not be of a heavy engineering character, will be undertaken at once, and it is thought that the line may be open to traffic before the end of the current year. The State Government is offering a substantial subsidy for rapid work, which, however, will have to pass the examination and approval of the State Engineer.

ANSWERING a question by Sir William Joynson-Hicks, Mr. Winston Churchill said that the cost of the Kantara-Hafa Railway was £1,300,000, exclusive of labour charges. The cost of maintenance for the current financial year is estimated at about £202,000. The revenue from traffic, other than military, is estimated at the present time at about 70 per cent. of the total earnings. The control of the railway is now vested in the Air Ministry, acting on behalf of the Colonial Office. The Palestine Government, which works the railway, shares any profit or loss equally with his Majesty's Government. It has not been asked to take over the ownership of the railway, which is situated in Egyptian territory.

SOME recent serious locomotive failures have prompted us to see whether the railway accident returns furnish any information to rebut the suggestion that has been made that these failures are an aftermath of the war, and the result of the compulsory neglect of a good deal of the inspection and the postponement of the repairs and renewals. The following are the figures for 1913 and for the three years 1919, 1920 and 1921:—Failures of machinery, springs, &c., of engines, 45, 25, 43 and 52 respectively; failure of engine tires, 10, 15, 12 and 14 respectively; failure of engine axles, 60, 63, 61 and 63 respectively. These figures would not appear to indicate that there is any cause for alarm.

DURING the last twenty years there have been sixty-two accidents in which passengers have been killed. Several railway companies have not contributed to this list. There are, for instance, the North Staffordshire, Furness, Hull and Barnsley, Midland and South-Western Junction, Stratford-on-Avon and Midland Junction, Wirral, Metropolitan District, London Electric, Mersey, Liverpool Overhead, all the minor English railways, all the Welsh except the Taff Vale and the Cambrian, the Great North of Scotland and all the Irish except the Great Southern and Western, Northern Counties, and the Cork and Bandon. The companies with only one fatal accident were:—London, Brighton and South Coast, Cheshire Lines, Metropolitan, Taff Vale, Cambrian, Glasgow and South-Western, Highland, and the three Irish railways first named. Those with only two accidents were the North-Eastern, Great Central and South-Eastern and Chatham.

THE "Cornish Riviera" express, the 12 noon non-stop Paddington to Torquay, and the corresponding up train are now composed of coaches 73ft. in length painted in the Great Western original colours—a chocolate base, with cream for the upper panels. On Monday last the down "Cornish Riviera" consisted of ten coaches weighing in the aggregate 355 tons 18 cwt. At Westbury two were slipped, and thence to Plymouth, North-road, the weight was 283 tons 16 cwt. The train was drawn by engine No. 4061, Glastonbury Abbey, and ran from Paddington to North-road without a stop. The timing was:—Paddington to Reading, 36 miles in 38 min.; to Newbury, 17 miles in 18 min.; to Savernake, 17 miles in 17 min.; to Westbury, 25½ miles in 22 min; to Castle Cary, 19½ miles in 23 min.; to Taunton, 27¼ miles in 27 min.; to Exeter, 30 miles in 31 min.; to Newton Abbot, 20 miles in 26 min.; to North-road, 32 miles in 45 min. On three occasions—at Frome, Castle Cary, and Exeter (St. Thomas)—speed was reduced to 10 miles per hour. The following day the return trip, with 283 tons 16 cwt., drawn by engine No. 4006, Red Star, was two minutes before time into Exeter, and ran the 173¾ miles from Exeter to Paddington in 178 min., arriving two minutes before time.

Notes and Memoranda.

IT is announced that the American Navy has made successful tests of a new radio sounding device which registers ocean depths by measuring the time which a sound takes to travel from the ship to the bed of the ocean and back. The tests were made during a voyage of the destroyer Stewart from Newport to Gibraltar.

A RECENT improvement in nickel plating consists in the use of nickel fluoride in place of nickel chloride or sulphate, the fluoride giving a finer grained deposit with higher tensile strength and greater hardness. Nickel may be plated from certain solutions as a black deposit. A solution giving black nickel contains nickel and zinc sulphates, cyanide, arsenious acid, ammonia, and ammonium carbonate.

SOME tests on reinforced concrete roads by the American Bureau of Public Roads showed that a 6in. slab, after deflecting under a loaded 5-ton lorry, does not recover its former position for more than two hours; after long-continued traffic, this rate of return is somewhat slower, on account perhaps of fatigue of materials. Concrete surfaces will carry, it was found, about 3,500,000 tons of traffic on solid-rubber tires without abrasion.

AFTER considering the relative merits of 110,000 and 220,000 volts as the pressures for transmitting some 140,000 kilowatts a distance of 250 miles, the Pacific Gas and Electric Company, San Francisco, has decided to adopt the higher voltage. It is estimated that the transmission line will cost double the amount required for a 110,000-volt line, but that the transmission losses will be reduced to 3.5 per cent. per 100 miles of circuit.

DURING the first quarter of this year the output of black coal in the republic of Czecho-Slovakia was 2,679,865 tons; that of lignite 4,710,725 tons. In the first case, 74,357 miners are employed, while in the brown coal pits 49,226 are engaged. The output of black coal per miner per shift was 12.78 cwt., which is 1.24 cwt. more than in 1921. The output of each miner per shift in brown coal was 1.57 tons, or 3.32 cwt. increase on the 1921 output.

A FRENCH monthly scientific magazine called *l'Onde* gives two illustrations of apparatus invented by M. Jules Guillot for utilising earth currents of electricity. The apparatus is the outcome of eight years' work, and is said to have given important results. Unfortunately, a description of how it acts is deferred till a future issue of the magazine, but we are led to infer that ordinary electric lamps can be lighted by earth currents, and that when a special static transformer has been made, distribution will be possible.

IN the recently issued report of the Departmental Committee on Ship's Navigation Lights, published by H.M. Stationery Office, it is stated that the time is now overdue for the establishment of more precise standards and requirements for the navigation lights carried on board British ships, that the necessary knowledge and experience is available for this to be done, and it is recommended that such standards and requirements be enforced as soon as may be practically possible. The report, which covers thirty pages, sets out in detail the recommendations of the Committee.

THE results of experiments on the electro-magnetic screening of a triode oscillator, described by Mr. R. L. Smith-Rose in the "Proceedings" of the Physical Society of London, show that the most complete method of screening a valve set is to enclose it in a box made of metal of suitable thickness for the frequency used, and to seal hermetically all joints in the box and its lid. The smallest crack or hole is sufficient to allow of the escape of a detectable amount of high-frequency energy, and iron is far more effective than copper of the same thickness in preventing direct penetration of radio-frequency magnetic fields through the metal.

A MACHINE for producing direct current from alternating current, designed by Mr. W. E. Highfield and Mr. J. E. Calverley, is described in the *Electrical Review*. It consists essentially of a static transformer member and of a fixed commutator with revolving brush gear driven by a small motor running in synchronism with the alternating current supply to the primary windings of the transformer. Secondary windings on the transformer connect to the commutator, which converts the alternating current to direct current. Several groups of secondary windings may be placed on the transformer, and by connecting them to commutators connected electrically in series, high-pressure direct current is produced. Each commutator in the machine first made deals with a pressure of the order of 12,500 volts, so that the eight commutators provided give 100,000 volts. This machine is termed a "transverter," since it first transforms and then converts the alternating current to direct current. The efficiency of the apparatus is said to be of the order of 95 per cent. for a 2000-kilowatt size.

IN commenting on the explosion of a large drying cylinder in a Blackburn mill, the Engineer Surveyor-in-Chief, Board of Trade, makes the following remarks:—"In the working of steam vessels which have failed by explosion, it has frequently happened that prior to the explosion there have been indications of weakness which, had they been observed and appreciated at their proper value, should have led to the discontinuance of the use of the vessel in time to avoid the explosion which ultimately occurred. In this case the cylinder failed after repairs to the riveted longitudinal seam, which were probably occasioned by panting movements of the corroded and weakened plate, and it was unfortunate that the possibility of such action was not considered when the cylinder was repaired, and that advantage was not taken of the opportunity then afforded to make a close and effective examination of its condition. Drying cylinders are most liable to failure during the process of heating up in preparation for the day's work, and the heavy stresses to which they may then be subjected, by the weight of contained water and the possible variation of internal pressure from atmospheric pressure, or even partial vacuum, to the full working pressure, makes it essential to observe greater care in the process of draining and heating up than has been shown in many of the cases dealt with in these reports."

Miscellanea.

DURING the recent Scottish Six Days' Light Car Trial, the petrol consumption of one four-seated car, having an engine of 1453 cubic centimetres capacity, proved to be 41.112 ton-miles per gallon.

WE are informed that Sir William Larke has been appointed director of the National Federation of Iron and Steel Manufacturers, and will take up the duties of his new post on September 1st.

ACCORDING to a telegram from Tokyo, a naval airship, exploded in Japan on July 10th. It is a complete wreck. The hangar in which it was housed at Yokosuka was also destroyed There were no casualties.

A BILL has been introduced in the United States Senate authorising the President to give Poland, as the nucleus of her navy, six American warships destined to be scrapped under the Washington Agreement for the limitation of naval armaments.

A MOVEMENT is being made, according to the *Morning Post*, to re-establish the Russian platinum industry. Some important names are connected with the enterprise, but the private company to be registered in connection with the undertaking will only have a small capital.

IT is reported from New York that Rear-Admiral Fiske, acting as honorary president of the American Eagle Company, which is planning a giant commercial hydro-aeroplane to carry one hundred persons, has dispatched to England and other countries a friendly challenge to compete with similar giants in the circumnavigation of the world. Speed is to be a secondary object to safety and efficiency.

THE President of the British Engineers' Association (Mr. Nevile G. Gwynne) and the Council of the Association, which has undertaken the organisation of the Mechanical Engineering Section of the British Empire Exhibition, 1924, paid an official visit to Wembley Park yesterday for the purpose of inspecting the site of the Exhibition, and the progress made in the erection of the various buildings, the work on which is rapidly proceeding.

AN official announcement has been made by the Dundee Coal Company, of Natal, to the effect that the by-product and coke plant, which has been in course of construction for the past two years, has been started successfully. This plant has been designed to manufacture coke, tar products, including tar acids, naphthalene, benzol, sulphates, &c. It is anticipated that the financial results will justify the expenditure. Important contracts have already been made for the sale of coke and tar in South Africa.

IN the first issue of the *Quarterly Journal* of the British Chamber of Commerce in Belgium, the editor remarks that some British manufacturers seem to be under the impression that Belgium can be used as a dumping ground for goods they cannot get rid of in their own country. To some extent this was true, he says, immediately after the Armistice, but since that time Belgium has reached a high state of industrial efficiency, and those manufacturers who wish to sell to her must come prepared to supply her with what she wants and not simply with what they want to dispose of. Our competitors on the eastern frontier take the trouble to acquaint themselves in advance with her requirements.

THE Brazilian Government has expressed its approval of a modified project for the construction of port works at the town of Parahyba, some twelve miles from the south of the Parahyba River. The existing accommodation is to be considerably extended and the dock space lengthened. The railway station is to be transferred to a more convenient site, a new Customs house constructed, and a wide avenue opened from the business centre of the city to the docks. The construction plan includes the dredging of a 6 m. channel from the mouth of the river. A contract has been entered into with a British firm for the carrying out of these undertakings, the total cost of which is estimated at 15,111,242 milreis, roughly £625,000, but this is regarded as a merely preliminary estimate, and will probably be exceeded by almost as much again before the entire work is completed.

THE American Bureau of Standards has given its approval to the recommendations of a Committee of the National Fire Protection Association proposing the addition of some new safety rules to the National Electric Code relating to wireless telegraph installations. The proposed regulations provide for the protection of receiving and transmitting equipment against lightning effects, avoidance of risk of contact with neighbouring electric light and power circuits, and protection from effects of high potential surges in the lines supplying power to the equipment, as well as the ordinary requirements of sound construction. It is noteworthy that copper-clad steel wire is recommended throughout as an alternative to copper wire, owing to the fact that these two kinds of wire are practically equivalent in their conductivity for high-frequency current, while the former is stronger mechanically.

The whole belt of the Namib—coastal belt of South-West Africa—is diamondiferous. Stretching from the Orange River in the south to the Kunene in the north, and averaging 30 to 40 miles in width, it is, owing to the difficult nature of the country, only accessible at certain spots. The same belt is said to be richer in saltpetre than the coast of Chili. The copper mines are handicapped in that coal does not occur in the territory. Owing to the high cost of imported coal the mines are compelled to ship the copper ore, which means that only the high-grade mines can be worked. Tin, both alluvial and reef, has been discovered. The former has been worked for several years, but by very primitive means, so that but for the richness of the fields they could scarcely be made to pay. Large deposits of tinstone have recently been discovered in the Erongo Mountains, and the proposition has been taken over by a London syndicate, so that developments may shortly be expected. Vanadium is being worked in the Grootfontin district, tungsten had been worked in the Rehoboth district, and gold is known to exist, but payable reefs have not yet been discovered. Galena, asbestos, cinnabar, and many other metals are known to exist, but payable propositions have yet to be found.

SOME EXHIBITS AT THE ROYAL SHOW

(*For description see page 36*)

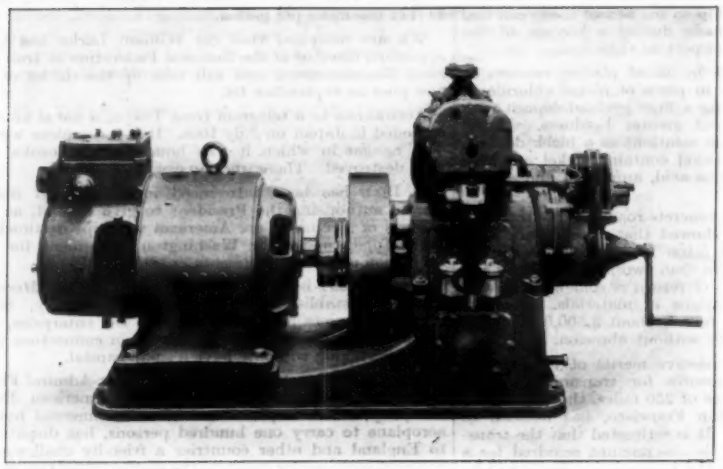


FIG. 20—AUSTIN 2-K.W. AUTOMATIC ELECTRIC LIGHTING SET

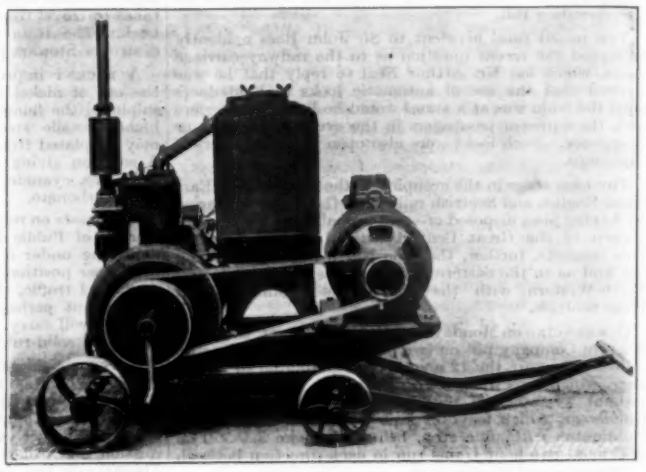


FIG. 21—AUSTIN PORTABLE POWER PLANT

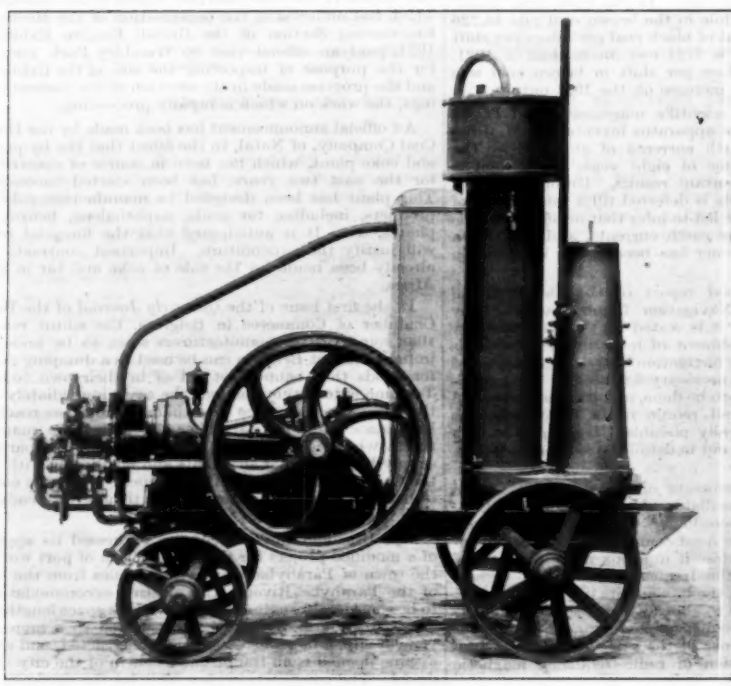


FIG. 22—NATIONAL 5-H.P. WOOD REFUSE SUCTION GAS PLANT AND ENGINE

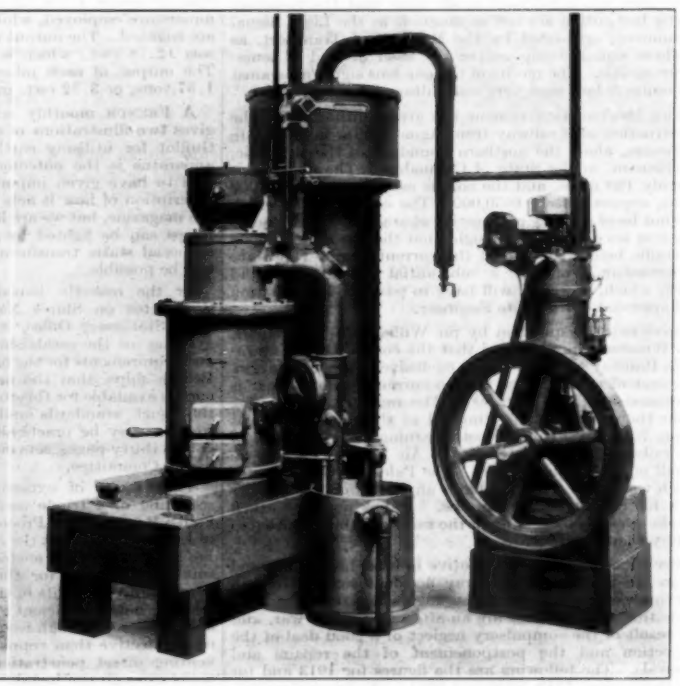


FIG. 23—NATIONAL 6-H.P. SUCTION GAS PLANT AND ENGINE

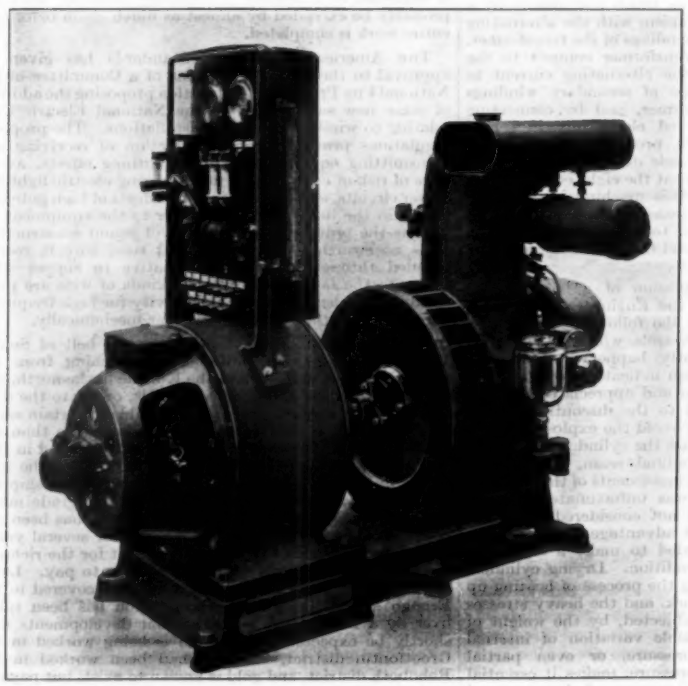


FIG. 24—WALLACE 3-H.P. SINGLE SLEEVE-VALVE ENGINE AND DYNAMO

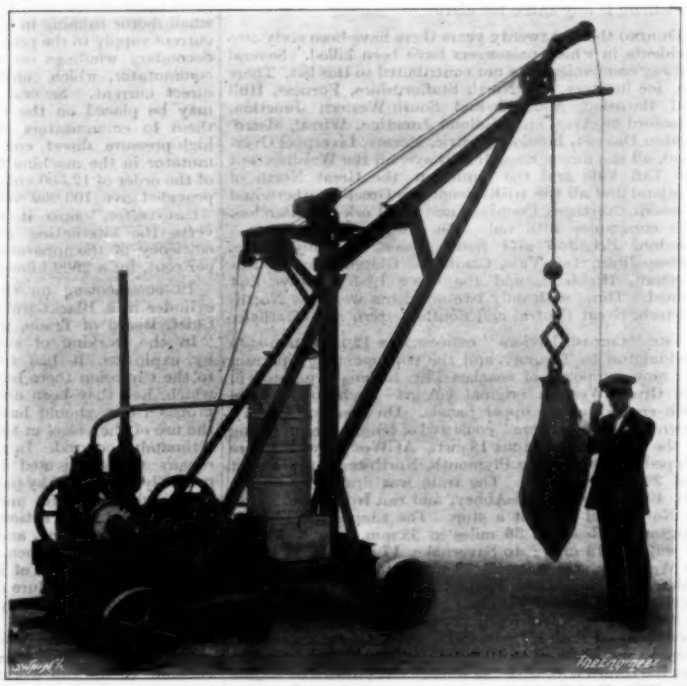


FIG. 25—ALEXANDER PORTABLE CRANE

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Contents.

THE ENGINEER, July 14th, 1922. PAGE

THE HEAT PUMP. (Illus.) 27
SHORT HISTORIES OF FAMOUS FIRMS.—No. XIII. (Illus.) .. 29
THE GENNEVILLIERS CENTRAL POWER STATION 31
THE CHALK FARM WIDENING, L. AND N.W. RAILWAY. (Illus.) .. 32
THE SOCIETY OF CHEMICAL INDUSTRY 33
LETTERS TO THE EDITOR—
Avoidable Waste in Locomotive Operation 33
Corrosion 34
The Hydrautomat 34
THE EFFICIENCY OF WATER TURBINES 34
A SEVEN-DAY JOURNAL 35
THE ROYAL SHOW AT CAMBRIDGE.—No. II. (Illus.) 36
RAILWAY MATTERS 39
NOTES AND MEMORANDA 39
MISCELLANEA 39
LEADING ARTICLES—
Heat Balances 41
Engineers and Professors 41
CHINESE ENGINEERING NOTES 42
THE INSTITUTION OF NAVAL ARCHITECTS.—No. II. 43
BAND RE-SAWING MACHINE. (Illus.) 44
A PORTABLE PUMPING SET. (Illus.) 45
ROLLED STEEL MOTOR LORRY WHEELS. (Illus.) 45
PROPOSED PUBLIC WORKS IN FRANCE 45
THE TESTING OF MATERIALS FOR SHIPBUILDING. (Illus.) 46
MANUFACTURE OF PIG IRON IN NEW ZEALAND 47
CATALOGUES 47
PRICES OF ENGINEERING MATERIALS DURING THE FIRST HALF OF 1922 48
A QUARTER'S SHIPBUILDING 48
AMERICAN FLUE DUST SINTERING PLANT 48
PROVINCIAL LETTERS—
Midlands and Staffordshire 49
Lancashire 49
Sheffield 50
North of England 50
Scotland 51
Wales and Adjoining Counties 51
CURRENT PRICES FOR METALS AND FUELS 52
FRENCH ENGINEERING NOTES 53
BRITISH PATENT SPECIFICATIONS. (Illus.) 54
FORTHCOMING ENGAGEMENTS 54
PERSONAL AND BUSINESS ANNOUNCEMENTS 54
LAUNCHES AND TRIAL TRIPS 54
PARAGRAPHS—
Presentation to Mr. Henry J. Spooner 51
A Century of Progress 51
Contracts 54

THE ENGINEER.

JULY 14, 1922.

Heat Balances.

Two ways of studying boiler efficiencies are in common use. For the sake of brevity we may describe them as the Academic Way and the Power-house Way. The former seeks for a complete heat balance and depends for its results upon an investigation made with the varied paraphernalia and large staff of the expert boiler tester; the latter is an everyday affair, which is concerned less with the "items" than the "tot." The consumption of coal or oil per horse-power or per kilowatt-hour is all that it troubles about. Its chief factors are the fuel weighed into the building and the units of power turned out. Looked at scientifically, it is all wrong, because it lumps together a great many variables; but looked at practically, it is the obvious matter-of-fact way of finding out if things are going right or wrong. If on a given occasion the makers of the plant have shown that one kilowatt-hour can be developed for three pounds of coal, then if more than three are consumed, something must be wrong; if less than these, then there are grounds for congratulation. It is very crude, perhaps, but it is very natural. It is just what men do daily with their own systems. If they are below par, and cannot screw themselves up to it by the familiar remedies, they call in a doctor; if they are above par, they congratulate themselves on their fitness. We speak of ordinary men and ordinary boilers; but just as there are exceptional men so there are exceptional boilers. We have always imagined that emperors, potentates and kings have medical men in continuous attendance on them, ready at once to adjust any slight derangement and restore the physical balance. With big boiler plants it is the same thing. A special boiler-engineer keeps a continual watch over them with calorimeters, coal weighers, draught recorders, autographic CO_2 apparatus, thermometers, flow meters, and so on. At any moment he must be able to place his finger on the seat of any ailment and prescribe the appropriate remedy. Only rich stations can afford these luxuries; the small power-houses have to do without a "doctor" at all; to be content with what they learn from the visits of the representatives of their boiler insurance companies, and, in case of need, call in the Harley-street of boiler engineering. If the monthly coal bills are fairly constant they see no cause to complain. Perhaps they are right. The improvement of their boilers by a few per cent., the most they could hope for, is a small affair, after all, and one cannot expect them to worry about the effect upon the country of the summation of all these little efficiencies.

Your real scientific test goes much further than the crude "coal against horse-power" test, and a good deal further even than the observations made in a perfectly conducted station. Years ago someone—we forget who at the moment—invented the heat-balance. It is an admirable device borrowed from the method of the accountant and assumed to be capable of equal accuracy. Assumed, that is, by those who examine the balance as it is presented to them by the expert. The expert himself knows that it is not so beautifully accurate as it appears to be, and that the balance has to be secured by "juggling with the coppers," or by frankly putting down, where it will not attract too much attention, "so and so by difference." The expert knows that none of his instruments are absolutely perfect and that none of his observers are absolutely free from personal error. He knows that he has to make assumptions with regard to consistency of temperature throughout a mass of hot gas, to accuracy of draught records, to the true average result of calorimeter tests, and so forth. If he insists on a run of many hours he may get very near a correct result; but if, as sometimes happens, a four-hour test is used, errors are certain to persist. All this the expert, who is honest with himself, knows full well, and yet, in order to make his balance, he will set down figures to the second and even third place of decimals. Here are a few taken from recent American boiler tests:—"Loss due to heat carried away by steam formed by the burning of hydrogen," 3.79 and 3.61 per cent. "Loss due to heat carried away in dry flue gases," 11.93 and 12.11 per cent. "Loss due to combustible carried away with flue gases, unconsumed hydrogen, hydrocarbons, radiation and *unaccounted for*," 3.07 per cent. It is as certain as anything under the sun that if any one of these figures is accurate it is so by chance and not by measurement. Mr. Alfred Cotton, research engineer of the Heine Boiler Company, in a paper on this very subject, which he presented at the spring meeting of the American Society of Mechanical Engineers, gives it as his opinion that the estimates of B.Th.U in coal may err by as much as two and a-half per cent., and that the measurement of water evaporated may be at least one per cent. wrong, so that on these items alone a possible error, up or down—surely no tester would enter too low a figure to the detriment of his client!—of three and a-half per cent. is possible. If we have any doubt at all about the probability of Mr. Cotton's estimate, it is that it is on the low side. We have to stretch our credulity to believe that the efficiency of human observation in a boiler-room reaches 96½ per cent. "There is," says Mr. Cotton, "nothing whatever to be gained by reporting efficiency more closely than the nearest tenth of one per cent., or even the nearest half. Not only is such apparent precision as 1 in 1000 unwarranted by the exigencies of boiler testing, but engineering judgment is quite unable to make use of it. It is mentally impossible to differentiate between the relative value of 79.9 and 80.1 per cent efficiency, and it seems only sensible to call it 80 per cent. Especially is such over-precision absurd, inasmuch as it is not certain that it was not really 79 or 81 per cent., or even a little further away."

Thus we see to what an absurdity the quest of the heat-balance has brought us. Mr. Cotton proposes that there should be a tolerance of 2 per cent. on all such balances, but sees some difficulty in that course. We suggest that an easier plan is to regard only the first figure after the point and convert it into its nearest whole number. The difficulty about the handling of tolerances would thus be removed, and efficiencies would be presented in whole numbers. The tester may properly return them in this form whether they balance or not, but the wise observer of such figures will knock off a few per cent. "according to taste" to cover the factor of human efficiency of observation.

Engineers and Professors.

YEARS ago practical engineers refused to have anything to do with theorists and professors. Let us not condemn them on that account. They probably served their generation better in hammering out the facts by patient endeavour than by arguing about them. Over and over again it happened that practice gave the lie to theory, and the engineer grew by degrees to doubt the professor and the theorist and to put greater reliance on his own instincts than on academical reasoning; he acted, in Lord Coleridge's words, "upon just and reasonable convictions founded upon just and reasonable grounds." We may be thankful that he did so. Nowadays we are like to fall into the opposite extreme. Engineering has grown vastly more complex than it was fifty years ago, and if practical engineers are no less ready to act upon

their own convictions than they were, they show a deference to professors and theorists, which is in sharp contrast to the ill-concealed contempt exhibited by their predecessors. That change is due in part to the professors themselves, and in part to the specialisation which has followed naturally upon the development of mechanical engineering. Professors are wiser men than they used to be. Nearly all of them have had an engineer's training, and many of them are in almost daily contact with practical problems. Hence they merit the greater attention they now receive. Men like Ayrton, Perry and Thompson, like Kelvin, Hopkinson and Nicolson, did much to put the professors right with the engineers, and there are many now living who follow in their footsteps.

Yet, as we have said, there is some danger that we shall fall into the opposite extreme. It is just as important now as it ever was that practical engineers should be close critics of the work of professors and experts. But what do we find in fact? We find that engineers as a rule are silent in the face of the professor, and that the discussions, such as they are, upon the work done in universities and laboratories turn usually upon rather unimportant details and miss the great essentials. It has been said sometimes that only experts can discuss the work of experts. Unfortunately, there is a great deal of truth in that statement. The flood of knowledge passes over the head of the workaday engineer, who, often enough, is not even conversant with the terminology employed. On the other hand, it does not infrequently happen that the practical man has experience that does not tally with that of the professor, and yet he remains silent because he cannot bring an array of ordered facts and figures to support his views, and he fears to break a lance with the accoutred expert. This serious defect might be corrected did the experts themselves more frequently fall upon each other. But outside the metallurgical world, where a "certain liveliness" occasionally displays itself in research circles, there is little active criticism between them save in those rare instances when a point of law has to be settled and their opposing views are subjected to the winnowing of legal cross-examination. Hence it comes about that a great many statements and assertions are sent out into the world without any proper examination at all. There is a tendency to assume that once a man has acquired the "scientific method" he loses all traces of human weakness in dealing with facts and figures. Frankly, we do not believe it. The researcher who is quite free from all preconceptions and prejudices, who is not inspired with a desire to prove his own case, who can resist the temptation to smooth out a curve when he wants it smooth or find a bump in it when a bump will suit his argument is just as rare as the witness who, in ordinary mundane affairs, can speak the truth, the whole truth, and nothing but the truth. The trained observer sees more accurately than the untrained, and records more precisely, but it still remains true that given a "twelfth immersion and a lively imagination you can see anything." Every statement ought to be examined with meticulous care and be subjected to searching cross-examination before it is finally accepted, and we cannot but regret the customary poverty of technical discussions on scientific subjects. We have sometimes pictured to ourselves a new kind of scientific meeting. The hall has become a court of law. The president is invested with the dignities of a judge. The jury is composed of eminent but impartial engineers. In the dock is an expert charged with the scientific crime of having issued a false statement. Below him are silks and juniors for the prosecution and defence, and around him witnesses for and against. The case is conducted with close observance of the rules of evidence. Sometimes in our imagination the "prisoner" is acquitted, sometimes found guilty, and sometimes the verdict is not proven. But whatever it may be, the truth, as far as it may be found in the evidence before the "court," is set down before all men.

We do not hesitate to say that even the professors, experts and researchers themselves would welcome a more searching examination of their results and deductions than is usually accorded. Into whatever errors they may fall, they are invariably honest in their desire to find the truth, and would be the first to acknowledge a mistake or to change an opinion if evidence required it. Praise no doubt is not less pleasant to them than to other men, but often enough they must feel that the best acknowledgment engineers could make of the importance of their work would be a critical scrutiny of it. How many of their papers drop into the limbo of Minutes of Proceedings, leaving no useful mark upon the engineering of the day, and how many of those worthy might be saved from that dull fate were interest in them aroused by energetic discussion!

Chinese Engineering Notes.

(From our own Correspondents.)

Peking.

A GOOD deal of dissatisfaction has existed for a long time amongst many British manufacturers' agents in China regarding the system under which orders have been placed for supplies for railways which have been financed with British capital. Hitherto it has been the privilege of only a small number of firms to tender for this business, and from time to time efforts have been made to induce the Chinese Government to adopt a system more in accord with the so-called "open door" policy. These efforts have not altogether been made in vain. In the case of the Peking-Mukden Railway, whose annual purchases amount to over £300,000, an agreement exists under the terms of which a British firm does all the buying on a commission basis. The Chinese Government has now decided that, in addition to that arrangement, it will organise a proper purchasing department in London. It has recently appointed a "British Supervisor of Purchases" for this railway, and it is hoped that this system will eventually be extended to all other railways financed by British capital. Mr. William Henderson, the Supervisor referred to, has had over twenty years' experience of Chinese railways, being chief accountant of the Peking-Mukden for that time. He will be accessible, through the Chinese Legation in London, to those manufacturers interested in railway supplies for this country.

During the Great War, when supplies were not available from England, a large number of orders for these railways found their way to America; but it is hoped that in the future everything possible will be purchased in England. Whilst China is in a very bad way financially, all railways under British control are doing well and are in a position to pay for everything they order. On the other hand, the purely Chinese railways are in a sorry plight, and although they are in urgent need of rolling stock and other supplies, they cannot pay and are not likely to be able to do so for years. This state of affairs is due entirely to the demands of the military authorities. In the recent war here the Peking-Hankow Railway was entirely taken over by General Wu Pei Fu and his forces. He moved the head office of the railway from Peking to his military headquarters, and what revenue there was he commandeered for his military expenses. Passenger traffic on this railway has been completely suspended for two weeks, and there seems to be little likelihood of a full resumption of traffic in the near future. The victorious General Wu is still moving large numbers of troops from the direction of Hankow to Tientsin and beyond with the object of completing his recent victory and driving General Chang Tso Lin outside the Great Wall into Manchuria. In the meantime General Chang is consolidating his new line of defence inside the Great Wall and has declared the independence of Manchuria and all the territory formerly under his jurisdiction. General Chang's declaration of independence came as a result of a mandate issued by the President dismissing him from office. It is not always easy to get rid of a Chinese military official, and the general impression is that we have not heard the last of General Chang Tso Lin. In the meantime there is no Government in Peking. Every likely candidate for the Premiership has been offered the post, but so far no one seems a bit keen. The real reason is that they are all sitting on the fence pending a complete settlement by arms or otherwise of the situation between Generals Wu and Chang. The President is powerless and is likely to lose his job as a result of his intrigue during these troubles. No official information can be obtained regarding the tenders that have been submitted for the Peking tramway scheme. It is believed, however, that difficulties have arisen in connection with the finances of the company, and there seems little likelihood of work being begun or any orders being placed for some time.

Shanghai.

Considerable uncertainty exercises the minds of buyers and sellers of machinery in Shanghai at the present time, there being so many undecided issues in the air, such as the unsettled policital conditions, civil war, instability of exchange, and last, but not least, the engineering lock-out at home. The municipal council at the ratepayers' meeting announced a budget of eight million taels and will have no difficulty in covering this amount by the issue of additional municipal debentures, which can be taken as being a gilt-edged security. No further increase of expenditure on machinery is anticipated for the electricity department, but this was to be expected, as the completion in the near future of the power plants up to an effective 125,000-kilowatt capacity gives that department a margin for a year or two with which to meet the growth of demand for power and light. The council announced extensions of the tramways, but some other means of quick transportation are badly needed in this already congested city, as the trams are filled to overflowing at the busy hours, in spite of what is practically a capacity time service. The Chinese are building roads outside the settlement area and are putting on motor omnibus services to various outlying towns, and when these roads, which are at present fair-weather roads, get into shape there should be a very considerable increased demand for motor vehicles, and if an arrangement between the Shanghai Municipal Council and the surrounding native authorities with regard to city planning and road construction could be made, there would be unlimited scope for the sale of motor transport vehicles besides an enormous increase in the number of sites for factories on land at an economical price. The high cost of land inside the settlement at present deters development considerably, and the congestion militates against rapid handling of cargo and also decreases the settlement's amenities from a human life point of view. The Chinese, however, resent any effort to expand into their territory, although it should be evident to them that good communication with this centre of industry would immensely increase the value of their land and business prospects.

I attach a Bulletin issued by the Republic of China Government Bureau of Information, parts of which you may care to reproduce. Hulutao is on the Peking-Mukden Railway, south of Chinchowfu.

THE NEW PORT OF HULUTAO IN GULF OF LIAOTUNG.

It is announced that tenders have been asked, and will be opened on June 9th, for the construction of harbour works at the Manchurian port of Hulutao, in the Gulf of Liaotung. The announcement portends the early commencement of an undertaking which has been canvassed for many years and which, when completed, will provide a third outlet by sea—if we omit Vladivostok and Antung from consideration—for the great and ever-increasing trade of Manchuria and Eastern Mongolia.

As long ago as 1908 the Chinese Government commissioned the late Mr. W. R. Hughes, a British engineer, who had had much experience in China, to conduct investigations with a view to the selection of an alternative port to Newchwang and Dairen. Mr. Hughes reported favourably on the possibilities of Hulutao. Work was started almost immediately after the recommendation and was maintained till the outbreak of the revolution, which gave China a new policital complexion. Since that time the project has been in abeyance—due to lack of funds—but the need of more harbour facilities has been emphasised with the passing of time, and the recent controversy between the Chinese in the Kwangtung Leased Territory and the Japanese over the introduction of the gold standard in Dairen has galvanised the Manchurian merchants into action. Discussions between the Ministry of Communications and the authorities in Fengtien, one of the three provinces of Manchuria, have resulted in an arrangement whereby the cost of harbour construction, estimated to exceed 10,000,000 Mexican dollars, will be divided.

The interest in the undertaking is very keen. From the point of view of Western commercial interests, which realise the importance of Manchuria to the trade of the world, the opening of the port of Hulutao—which, however, is not likely to take place for at least seven years—will be the best safeguard of the Hay doctrine of the open door. Dairen is in the Japanese Leased Territory. At the present time it absorbs the bulk of the inbound and outbound commerce of Manchuria and Eastern Mongolia. It has without doubt profited immensely by the isolation of Vladivostok. Formerly much of the Manchurian trade was carried north on the Chinese Eastern Railway and thence east on the Usuri Railway to Vladivostok, whence it was distributed to the world. Now Dairen has attracted the export business, and by the activities of the Japanese is bidding fair to rival other ports in the Orient as a first-class entrepot. The harbour is constantly improved, business facilities are abundant, and the South Manchuria Railway drains one of the richest regions in the world. The 1920 returns of the railway show a doubling of the goods receipts in two years, the figures being:—1918, 29,427,905; 1920, 60,993,912. Newchwang has but the memory of its former pre-eminence, and is handicapped by the fact that it is closed by ice from November to March and, moreover, has a shallow approach of about 19ft. of water. Hence it is the desire of the Chinese to build a new port which can compete on equal terms with Dairen and which will ensure for Manchuria at least one purely Chinese sea outlet. Hulutao has been chosen as the place which would meet this desire if it were developed. It is 110 miles north of Chinwangtao and 184 miles south of Mukden, and is connected with the main line of the Peking-Mukden Railway by a branch which joins the trunk system at Lienshan, about seven miles from Hulutao.

Manchuria is not standing still. Some fifteen million acres of arable land are tributary to Hulutao, and it is only the dearth of transportation that has made much of it unused except for grazing purposes. There are also many mineral deposits in the mountainous areas. Peipiao, 55 miles from Hulutao, and Tayaokou, 70 miles distant, are well known for the excellent quality of coal they produce. Then there are large forests of timber in the Tumen River region and the Kirin district. Most important of all is the wealth of agricultural produce. Soya beans, of which product Manchuria yields 70 per cent. of the world's supply, wheat, buckwheat, sesamum, kiaoliang, rice, millet and maize, are produced in abundance.

Hulutao is a promontory about five miles in length jutting out to sea. In the course of an exhaustive technical report on the possibilities of the harbour, Mr. Murray Sullivan summarises its advantages as an ocean terminal and as a port to serve Manchuria and Inner Mongolia as follows:—

(*a*) It occupies a very strategic position with reference to the railways now built and in operation, and also the lines which are proposed to be built to serve the vast, rich territory lying back of Hulutao. It is the logical gateway of Manchuria and Eastern Mongolia.

(*b*) It is practically an ice-free port the year round, whereas all the other ports in the Gulf of Liaotung experience considerable difficulty on account of ice during the winter months.

(*c*) It has deep water where the largest ocean-going ships may receive and discharge their cargoes.

(*d*) It is not subject to typhoons.

(*e*) The development of this harbour presents no serious engineering difficulties or other obstacles and the materials required for construction are, for the most part, readily available.

(*f*) The preparatory work has already been done and conditions are favourable for carrying on the work to excellent advantage.

The water rises 8ft. to 10ft. at spring tides, and Hulutao will be easy of access from the sea for shipping at all times.

The Institution of Naval Architects.

THE SUMMER MEETINGS IN PARIS.

No. II.*

THE morning session on Wednesday was held at the Collège de France, adjoining the Sorbonne, and Sir John Biles' paper on "The Stability of Large Ships," and Professor L. Guillet's paper on "Some Points of Interest in Connection with the Testing of Materials for Shipbuilding," were read and discussed.

THE STABILITY OF LARGE SHIPS.

The paper presented by Sir John Biles is divided into two sections, the first of which dealt with the stability of a ship on entering or leaving port, and the second with the stability of a ship at sea. In the first part the comparative method of obtaining the sufficiency of stability of a ship is described, and a special case is taken by way of illustration, figures for the degree of inclination and the draught due to a series of disturbing causes being given for three cases —(1) when the ship is in a fully laden condition leaving port; (2) in the arriving condition after crossing the ocean; (3) when the ship arrives with a small quantity of cargo. The figures show that "in all cases the draught of the ship arriving is not greater than that of the ship leaving," and that "even in the case where the ship is inclined to the greatest angle, that of the ship leaving port is not less than the others." The question of the heeling of the ship, owing to the action of the rudder when she is in smooth water, and the effect this heeling has on the minds of the passengers is also discussed. The author then deals with the question of adding water ballast to prevent the vessel from touching the bottom when rolling during entering port. In the second part of the paper, the question of stability is considered from two points of view, first, safety, and, secondly, the comfort of passengers. By safety is meant the freedom from liability to capsize, and the tendency to return to the upright is a measure of the stability. The causes which move the ship from the upright (*a*) the action of the sea, (*b*) the action of the wind, (*c*) the shifting of weights inside the ship, are in turn dealt with, and a series of curves is given showing the angles of heel caused by squalls and by steady winds.

Sir Westcott Abell, in opening the discussion, thanked Sir John Biles for the opportunity afforded to discuss an important question. In the newer ships there was a marked increase in the complexity due to such factors as fresh water, fuel oil, consumable stores, and the introduction of swimming baths. It was of supreme importance that the problem should be studied statically and dynamically in a complete and methodical manner. Standard conditions of comparison, both with regard to wind and wave effect must be laid down, it being borne in mind that absolute determinations were not required, but rather comparisons widely made and with suitable ships.

Professor Percy Hillhouse discussed the relation of length to breadth, and emphasised the importance of taking into consideration the draught when comparing similar ships. There was an inevitable tendency for the C.G. to be raised during the course of construction, the general opinion being that there was always room at the top. That effect should be carefully watched by the shipbuilder. We could not hope to measure the actual stability; but calculations based on correct assumptions held fully. Metacentric height would be always a comparative figure, and results should not be regarded as absolute, but comparative.

Professor Welch regarded the comparative method as the only one possible. In the paper presented, all the conditions and necessary factors for the intact conditions had been taken into account, but one feature should not be lost sight of—the ship might be in collision, and in the flooded condition a larger reserve of buoyancy would be necessary than when dealing with the intact condition.

M. Bertin, in a few reminiscent remarks, referred to his work on stability, and discussed some ships he had constructed.

Mr. W. J. Lovett said that we owed to France our original knowledge of the stability of ships. In comparing present-day ships with pre-war ships, there were several factors which seriously affected any comparisons made. They might be grouped under three headings—Legislation, Requirements of Passengers, and Owner's Requirements. Legislation required adequate boats and boat gear, and tended to deepen ships; on the part of passengers, there was a much greater demand for fresh water; and, finally, under present operating conditions, it was necessary for the owner to make all possible economies to secure a profit.

Sir John Biles, in replying to the discussion, referred to the work of Professor Hillhouse with the rolling machine at Glasgow University, and suggested that it might be possible by suitably arranged experiments to predict rolling conditions under any set of circumstances. It would be valuable if the results obtained were coded and expressed by Sir Westcott Abell. He was pleased to be associated with M. Bertin, who was the great protagonist of the study of the rolling of ships, and perhaps the most distinguished living member of the older school.

* No. I. appeared July 7th.

In the absence of Professor Guillet, his paper on "Some Points of Interest in Connection with the Testing of Materials for Shipbuilding" was read by the secretary. This paper is reprinted on page 46 of the present issue.

The discussion was opened by Professor Dalby, who complimented the author on bringing together a valuable series of tests. He did not share the author's view as to the difficulty of determining the elastic limit, and had for some years worked on the tensile test, and developed it so that it was now quite easy to make rapid tests which gave considerable information as to the behaviour of a metal under stress. He showed the first diagram from a new torsion machine, which records plus and minus torque values.

M. Doyère referred to the importance of improving the qualities of steel for naval construction which had been discussed in the previous day's papers, and the very necessary work which must be done on that subject.

Sir Archibald Denny made reference to the new Stromeyer torque testing machine at the National Physical Laboratory, which he thought would give valuable results. Strength and rigidity in new materials was essential. The 1912 Congress on Standard Testing had recommended that each country should study the notched bar test, with a view to unifying methods. An account of the British work on this subject was given in Publication No. 131 of the British Engineering Standards Association, and it was interesting to note from the paper that the two nations, working independently, had reached very close agreement with regard to the size and shape of the notches.

SCREW PROPELLERS.

The Thursday morning session was again held at the Collège de France, and the chair being taken by the Duke of Northumberland (President), General G. Rota, of the Royal Italian Navy, read a paper on "Further Experiments on Contrary Turning Co-axial Propeller Screws." This paper records further work which has been carried out at the Experimental Tank at Spezia with a modified apparatus, which enables the thrust and the turning force of each screw to be determined separately and in combination. Reference is made to the results of experiments conducted in 1909 in the Royal Dockyard of Castellamare di Stabia on a steam launch on which the single propeller had been replaced by two co-axial contrary turning screw propellers, and also to Mr. Luke's paper of 1914 on "Further Experiments upon Wake and Thrust Deduction." Curves are given by General Rota showing the relation of thrust, turning force, and efficiency for various arrangements of ordinary and contrary turning co-axial propellers. The results obtained are compared with Mr. Luke's investigations, and the bearing of the co-fixial contrary turning screw propeller on hull efficiency is discussed. Reference is made to Sir John Thornycroft's screw turbine propellers, and Herr Wagner's counter propeller and their applications. In the opinion of General Rota, double contrary turning co-axial screw propellers would be perhaps suitable in submersible craft with the object of obtaining the simultaneous operation of both motors, electric and Diesel, at the surface.

Mr. Luke said that the subject was difficult to debate, but that it was gratifying to know that the experimental data which had been furnished by his company had proved of interest, and that where the experiments were parallel agreement in results had been obtained. Referring to the earlier experiments of General Rota, he pointed out that there was no indication of the efficiency of the ordinary single-screw propeller which was used on the launch. It was necessary to know that, for otherwise the gain in efficiency might be largely illusory.

Sir Archibald Denny said that his experience was that there were many fallacies in trying to gain screw efficiency. His firm had made many experiments on this subject, and they had been mostly unsuccessful. They had tried the Wagner propeller, with little success. Quite recently, they had reintroduced the Napier vane propeller, which was partly immersed, with a view to improving the efficiency of stern wheels and vessels with tunnel shafts for shallow draughts. The experimental installation had given results showing an efficiency of about 74 per cent. On the whole, he regarded the straight screw as being the most satisfactory arrangement.

The Duke of Northumberland said that the Institution was honoured by the presence of such a distinguished member of the Royal Italian Navy, and he thanked General Rota for his paper.

Mr. W. J. Lovett then read a paper on "The Proportions and Block Coefficients of Merchant Steamers." It contains an able and lengthy analysis of the particulars of a large number of cargo ships, accompanied by many tables. It was the last paper to be presented.

VISITS AND EXCURSIONS.

Any account of the Paris Summer Meetings would be incomplete without some mention of the interesting visits and social functions which were enjoyed by the members. During the afternoon of Monday many were present at the reception given by Monsieur and Mlle. Bertin at their house near the Sorbonne, and in the evening an official reception took place at the Ministere de la Marine, Place de la Concorde, when members and guests in number about a thousand were received by the Minister of Marine and Mme. Raiberti. The charm of the old French music and dances executed by distinguished artistes of the Opera will long be remembered, and much interest was shown in the historical apartments and their famous tapestries. Wednesday afternoon was devoted to visits to works in and around Paris, the following firms having announced their willingness to receive visitors:—Messrs. Renault, Billancourt; Babcock and Wilcox, La Courneuve; Delaunay Belleville, Saint Denis; Société de Constructions Mecanique, La Courneuve; G. A. Niclausse, Paris; and the Société Oxylithe, Asnieres. The majority of the party visited the Renault Works at Billancourt, where the extended factory for the mass production of standard cars and lorries was inspected and the process of manufacture from the preparing of the raw material up to the finished product was followed. Several interesting types of wagons and lorries were noted, and an example of the petrol locomotive recently described in THE ENGINEER was seen.

The dinner of the Institution was held at the Hotel Continental on the evening of Wednesday, covers being laid for upwards of 150 guests. The chief speakers of the evening were the President (the Duke of Northumberland), the Minister of Marine (M. Raiberti), Lord Aberconway, Vice-Admiral Le Bris, and Professor Rateau.

The afternoon of Thursday was devoted to visiting the Chateau and Park of Versailles, and after leaving Versailles, the members were received by Madame Philippe Berard, at the Chateau de La Jonchère. In the evening a musical soirée was given by the President and members of the Ecole Centrale Association, Champs Elysées. This Association was founded by Royal Charter in 1867, and now consists of 7000 former members of the principal College of Engineering in France. A most interesting evening was spent, and the members are to be congratulated on their well-arranged and artistically decorated headquarters and the excellence of the theatrical and musical entertainment they provided. Friday was spent at Rheims and the devastated areas and battlefields at Berry-au-Bac, where the President laid a wreath at the foot of the memorial erected in memory of the French who fell in the first attack of the French tanks on April 16th, 1917. The monument dedicated to the 2nd Devons and the famous Hill 108 adjoining the Aisne Canal were also seen. An interesting event in the day was the visit to the champagne factory of Pommery and Greno, and the inspection of the underground storage caves, which were used as schools and churches during the bombardment of the town. Luncheon at Rheims was provided by the Association Technique Maritime.

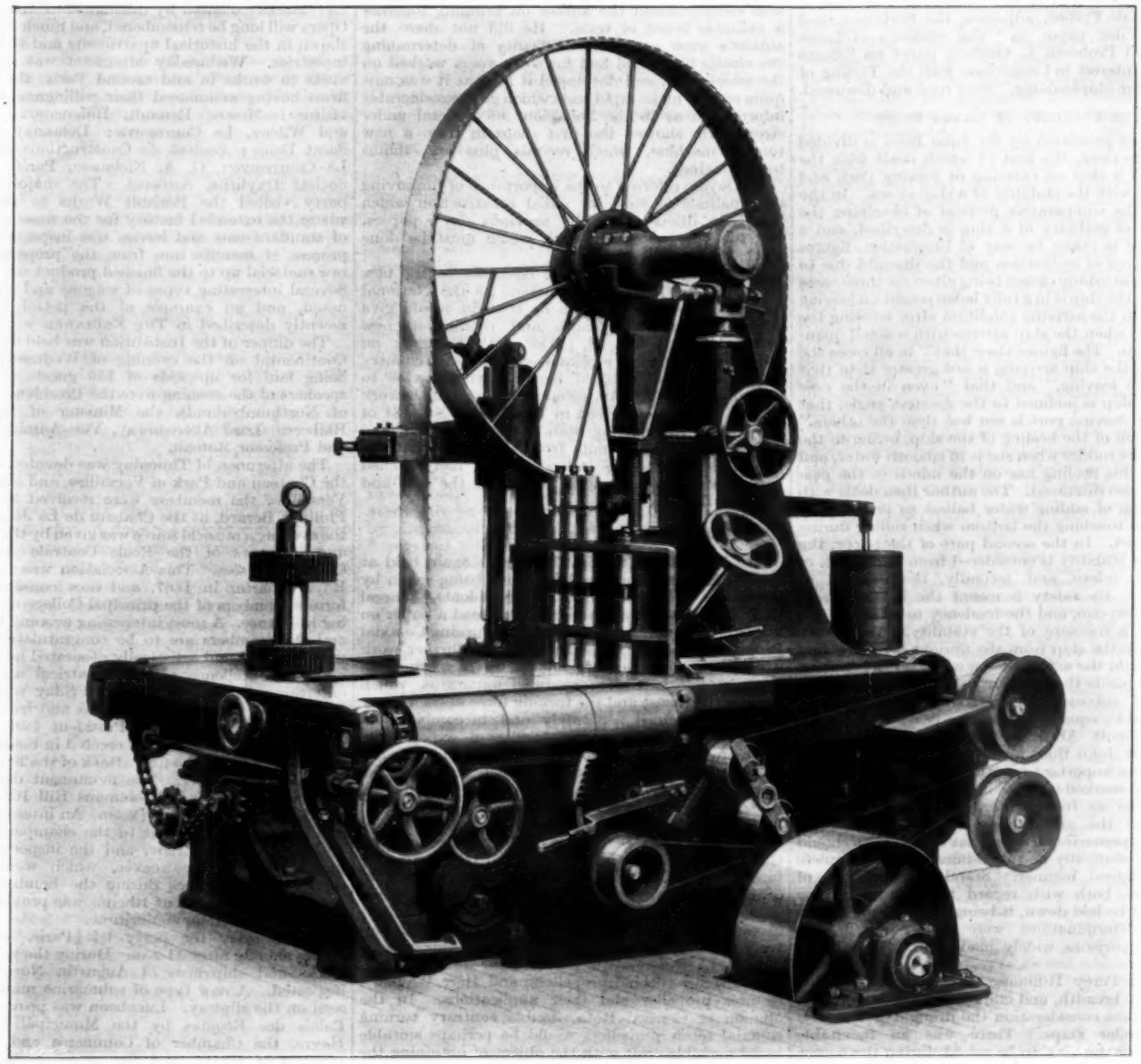
On Saturday the party left Paris, arriving at Havre shortly after 11 a.m. During the morning the works and shipyards of Augustin Normand were inspected. A new type of submarine minelayer was seen on the slipway. Luncheon was provided at the Palais des Regates by the Municipal Council of Havre, the Chamber of Commerce and the Shipbuilders of Havre, and the speeches made by M. Herman du Pasquier (President of the Chamber of Commerce), the Sub-prefect of Seine Maritime, the Mayor of Havre, Sir John Biles, and the President (the Duke of Newcastle) formed a fitting conclusion to the week's programme, expressing, as they did, the hospitality of the French authorities, institutions and people, and the appreciation of the members of the party of the great kindness they had met with during the week in France.

After luncheon, the visitors were conducted through the works of the Forges et Chantiers de la Mediterranée, Atliers de la Gironde, and the machine shops and new shipyards of Schneider and Co. In nearly all the factories a considerable amount of locomotive repair work was in hand, and at Messrs. Schneider's Havre works two new slow-speed Schneider-Diesel engines for cargo ships were seen on the test bed. These engines are of the six-cylinder two-stroke type, and are designed to develop 1500 brake horse-power at 140 revolutions per minute and 1800 brake horse-power at 150 revolutions. Valve scavenging is employed. The cylinder covers are of cast steel. Tea was served at the Harfleur works of Messrs. Schneider, where the gun shops were inspected. At the present time a large number of machines are working on a contract for guns and ammunition for the Spanish Government. Perhaps the two outstanding features of these works were the well-equipped research and testing laboratories and the aviation department, where a new all-metal aeroplane is in course of construction. The planes of this machine are 32 m. (approximately 115ft.) in length, and they are framed and constructed in duralumin. We understand that the machine will be driven by four 400 horse-power engines, and that its weight complete will amount to about 10 tons. As designed it may be used either for military or passenger service.

The major portion of the party left Havre for Southampton on Saturday evening, some members remaining over till Monday, when the new shipyards of the Chantiers Navals Français at Caen were visited.

BAND RE-SAWING MACHINE

THOMAS ROBINSON AND SON, LIMITED, ROCHDALE, ENGINEERS



Band Re-Sawing Machine.

WE give above an illustration of an improved band re-sawing machine which has recently been put on the market by Thomas Robinson and Son, Limited, Rochdale. It has been designed with the object of producing accurate work at a high rate of feed, and to be, at the same time, easily adapted to meet general requirements. The makers claim that it will re-saw deals, battens, and large flitches at varying rates of feed up to 200ft. per minute. The largest flitches can also be flat cut, for which purpose the vertical feed rollers can be readily removed. The machine can also be adapted for cutting round logs if required. The saw pulleys are mounted on heavy steel shafts which revolve in double-row ball bearings, as shown in the sectional drawing, and the shafts are tapered to receive the saw pulleys, which are bored to suit, and secured by lock nuts with fine threads so as to ensure the true alignment of the pulleys.

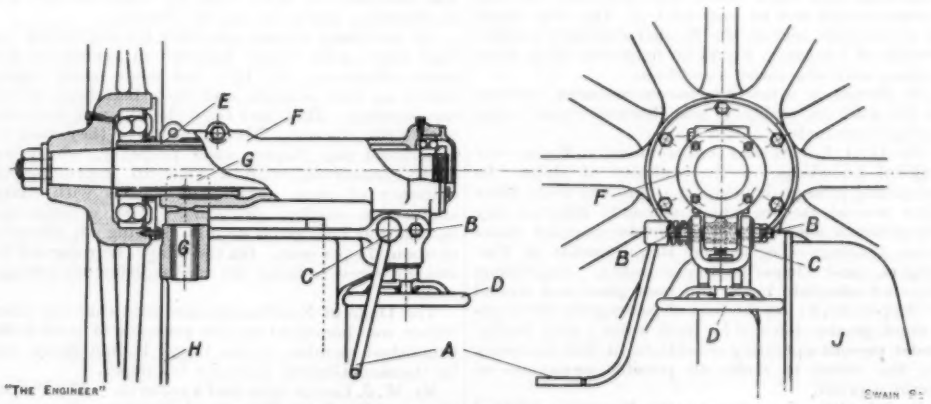
In the sectional illustration, A is a lever by means of which the shaft on which the pulley is mounted can be moved laterally through the medium of the square-threaded screw and nut C, the movement being limited by the screws B. D is a hand wheel and screw for tilting the shaft and "tracking" the saw on the pulleys. E is a steel bush which supports the inner race of the ball bearing, and F is the top bracket which supports the bush. This bracket is mounted in a swivel fork G. H is a vertical sliding saddle supporting the top pulley, &c., on the frame J.

The upper pulley is specially constructed, and has staggered arms radiating from a dished boss in which the bearing is housed. In this way, overhang of the pulley is avoided, and the stress on the saw falls directly over the centre of the bearing. The pulley actually shown in the illustration has a weldless steel rim and steel spokes. The lower pulley is mounted in a manner similar to that of the upper one, and is cast solid with a heavy rim. It is thus considerably heavier than the upper pulley, and is so constructed to prevent any possibility of the latter over-running. The straining device is very sensitive, which allows of the use of a very thin saw blade, and a saving in timber to be effected. The stress is transmitted through hardened steel knife edges, and is variable by means of sectional weights suspended from the end of a lever.

The feed mechanism has vertical and horizontal feed rollers, and the feed is adjusted by means of a "V" belt variable gear through a wide range, which can be varied while the machine is in motion.

The vertical feed rollers shown consist of two fluted rollers of large diameter carried on a spindle and radial arm pivoted below the table. The spindle which carries the vertical rollers fits into a socket, and can be speedily removed when cutting wide slabs or flitches. The rollers are adjusted towards the fence by the hand wheel seen in the foreground, while the foot pedal brings them away from the fence to suit the varied widths of timber being sawn. Horizontal feed rollers are arranged both in front and behind the saw. They are driven by chain gearing, and can be worked in conjunction with the vertical rollers, or separately as desired. The fence, it is claimed, is of improved design, and has quick adjustment. It has a rack-and-pinion movement, with single locking device, and a screw with a graduated index for fine adjustments. For cutting weather boards, &c., it is arranged so that it can be canted. The saw guides are provided with adjustable hardwood packings placed above and below the table. The upper guide is counterbalanced and supported from the fence side so as to avoid any obstruction when sawing wide timber. It can be opened quickly and easily for changing the saw. Cleaning devices are provided for both saw pulleys to keep them clear of pitch and gum and maintain the blades in a clean condition.

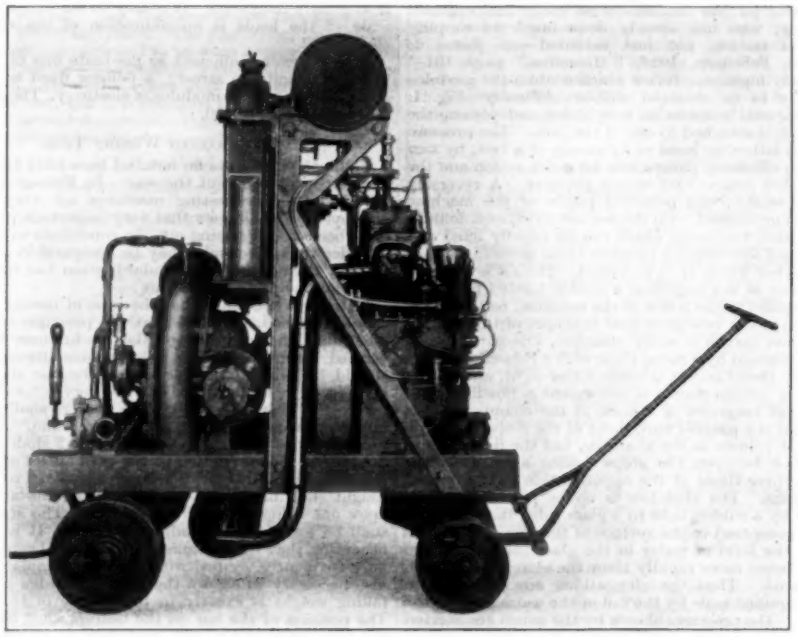
The saw is made in two sizes, and the following are the leading dimensions of the larger-sized machine:—Saw pulleys, diameter 60in.; width of saw, 7in.; length of saw, 29ft. 6in.; vertical adjustment of top saw pulley, 10in; maximum depth of cut, 30in.; maximum distance from saw to fence, 18in.; maximum distance from saw to vertical roller, 16in.; fast and loose pulleys diameter, 27in.; width of face, 9½in.; speed of pulleys, 550 revolutions per minute; approximate brake horse-power required, 40; floor space, width, 9ft.; total height, 10ft.; projection of lower pulley below the floor, 30in.



BEARINGS OF BAND RE-SAWING MACHINE

PORTABLE PUMPING SET FOR CHINA

THE PARSONS MOTOR COMPANY, LIMITED, SOUTHAMPTON, ENGINEERS



A Portable Pumping Set.

IN the accompanying illustration we show a small portable pumping set which has recently been completed by the Parsons Motor Company, Limited, of Southampton, for shipbuilding service in China. The set has been designed to work in constricted spaces, and its dimensions are such that it can be accommodated in a space 4ft. 6in. long and 5ft. 6in. high. The engine is a standard 7 horse-power Parsons unit running on paraffin, with forced lubrication, and it is furnished with a high-speed governor and the usual hand controls. The pumping plant comprises a 4in. Worthington-Simpson pump capable of delivering 250 gallons per minute against a head of 30ft., and a hand priming system with a semi-rotary pump is combined in the plant. The water-cooling system is of interest, alternative systems of cooling being provided, so that in the event of the water which the main pump is dealing with being dirty or otherwise unsuitable for cooling the engine jackets, a radiator and fan can be brought into operation as shown in the illustration we reproduce. With a view to easy transport, the combined set is mounted on a frame with wheels, and eyebolts are attached to the frame for the purpose of lifting and slinging. Special quick action hose couplings are provided for attaching the hose to the pump and for interconnecting the various lengths of hose.

Rolled Steel Motor Lorry Wheels.

A NEW method of making wheels for motor vehicles, and especially for motor lorries, has recently been devised by the Bethlehem Steel Company, of Bethlehem, Pa., the representative of which in this country is the Consolidated Steel Corporation, of 139, Fenchurch street, London, E.C. 3. The wheels are made from specially rolled deep webbed I beams, with flanges of correct shape to form the rims of the wheels, one piece of beam of the proper length making one pair of wheels. The method of manufacture will be readily understood by the aid of the accompanying engravings. As shown in Stage I., Fig. 1, holes to outline the spokes of the wheels are first of all punched out at regular intervals from the web. This operation is followed by running the beam through a die which rounds off the edges set up by the punching. The next operation—see Stage II., Fig. 1—not only completes the spokes and gives the parts of them which go to make up the hub the correct form, but also divides the beam into two identical halves, each of which will make one wheel. In the third stage the spokes are grooved or dished, and are staggered to provide the requisite lateral strength, these two operations being performed simultaneously in a machine press of special design. The next process is to bend up the ends—as shown in Stage IV., Fig. 1—which is done in a specially designed powerful press, the horns of the ram of which are furnished with rollers which press on the flange of the beam and roll along it as bending proceeds. The beam is then bent more or less into wheel, as shown in Fig. 2, the hub spacer—shown separately at the left-hand side of the engraving—being inserted before the bending is effected between the staggered spokes. For the two bending processes a very large machine measuring 118in. between the housings is used. It has a die space of 72in. and a stroke of 36in. One machine is used for the two processes, but with different dies for each.

The next process is to weld the two ends of the half beam so as to form a complete felloe, and it is done by electric butt welding in a specially designed machine in which the pressure required to consolidate the weld is provided by two hydraulic cylinders. After the "flash" left by the welding operation has been removed and the joint smoothed, the wheel is placed in a hydraulically operated tire setter, which "sizes" it to the required limits and makes it accurately round. Finally, after the spoke ends have been brought into contact with the hub spacer in a double-crank press, the wheel centre bored out in a vertical turret lathe, and the felloe faced to width, holes are bored through the wheel hub and the hub spacer, in a multiple spindle machine, and the wheel is ready to be assembled with the hub core and the brake drum. Chain

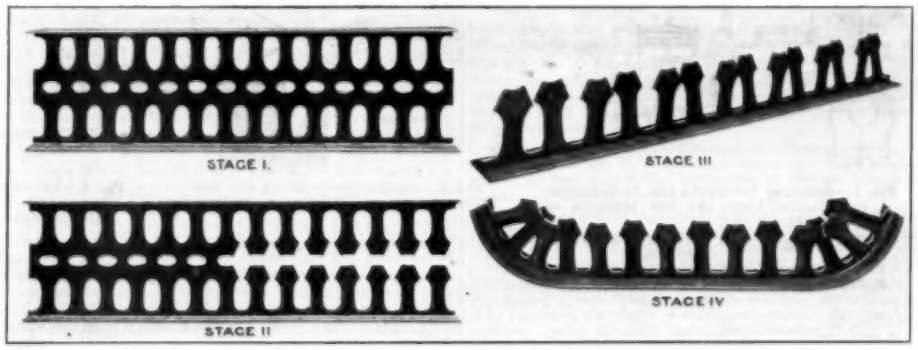


FIG. 1—MAKING LORRY WHEELS FROM A STEEL BEAM

hooks may be attached by riveting through holes punched in the felloe.

A feature of the wheel is that the inner, or hub, ends of the spokes are so shaped as to key with each other on both sides of the hub spacer which forms the wheel hub. The spoke-ends, in fact, have two full circular bearings on the hub core. Each spoke is bolted to the two spokes on the opposite side of the spacer, one of the opposite pair being ahead of, and other behind, the first spoke. This arrangement, it is claimed, forms an interlocking keystone construction of great strength and durability. It is further claimed for these wheels, amongst other things, that they are lighter than any other all-metal wheels, and have strength far in excess of service requirements; that as regards resiliency, they compare favourably with wood wheels; that there is practically nothing to get loose, wear out or need replacement; that they are light in weight, durable and low in cost.

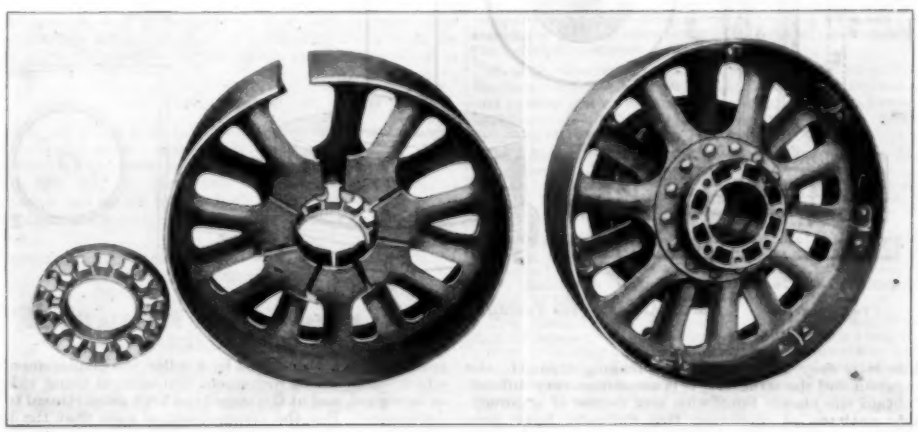


FIG. 2—THE WHEEL READY FOR WELDING

FIG. 3—COMPLETED WHEEL

Proposed Public Works in France.

THE following additional particulars of the programme of the first section of works of public utility, which the French Government proposes that Germany should be asked to execute in France, in virtue of Article 19 bis, Annex 2 of the Treaty of Versailles, have just been published. The proposals have been elaborated in accordance with the principle that work which is capable of immediate realisation should be chosen. The five schemes which they comprise are as follows:—

(1) The harnessing of the Rhone; approximate cost, 3,253,000,000f.

(2) The regulation of the Truyère; estimated cost, 210,000,000f.

(3) The regulation of the Dordogne; estimated cost, 290,000,000f.

(4) The construction of a tunnel between Saint Maurice and Vesserhague (3260 m.); estimated cost, 64,000,000f.

(5) The construction of two parts of the North-East Canal (junctions: Sarre-Moselle-Meuse and Meuse-Schelde); estimated cost 1,010,000,000f.

Total, about 4,827,000,000f.

The financial charges to be borne by France and Germany are to be divided as follows:—

	French share. Francs.	German share. Francs.
Regulation of the Rhone ..	595,000,000 ..	2,658,000,000
Regulation of the Truyère ..	81,000,000 ..	129,000,000
Regulation of the Dordogne	105,000,000 ..	185,000,000
Vosges Tunnel	500,000 ..	63,500,000
Nord-Est Canal: Sarre, Moselle, Meuse	88,000,000 ..	502,000,000
Meuse, Schelde Canal	59,600,000 ..	360,400,000
	929,100,000 ..	3,897,900,000

Apart from the possibility of their immediate realisation, these schemes were chosen because once completed they are likely to make an immediate return for expenditure, and also because, in view of the proposal to employ German labour, it was necessary to choose work which did not involve the presence of Germans in large centres or in scattered groups throughout the country. Thus, three out of the five schemes are concerned with hydro-electric power stations, at which large groups of workers can be concentrated at one spot in sparsely inhabited districts. The canal improvements are needed to link up the coalfields of the North and the Sarre with the industrial centres of Alsace and Lorraine, and the Vosges tunnel is indispensable for the development of the industries of Mulhouse.

French engineers will superintend the execution of the schemes, but the contractors will be German, and they will provide labour and materials. The workers will be housed in cities of huts specially provided for them, and will be provisioned by the contractors. In cases in which it is necessary for labour to be dispersed over a considerable

distance, the contracts will be given to French contractors and carried out by French labour. About a third of the material is to be supplied by France, the percentage, however, being based on the whole of the work to be carried out and not on each individual scheme to be executed. Thus, for the work in connection with the regulating of the Truyère and the Dordogne, it is proposed that the whole of the material shall be supplied by France. It is suggested that Germany should give France the right to manufacture spare parts originally supplied by the German contractors.

The work will be divided up as follows :—For the Rhone : 12,000 workers, both French and German ; the work estimated to last ten years ; approximate total wages, 1,300,000,000f. For the Truyère : 1800 German workers ; work estimated to last four years ; approximate wages, 55,000,000f. For the Dordogne : 25,000 German workers ; work estimated to last four years ; approximate wages, 82,000,000f. For the Vosges tunnel : 600 German workers ; work estimated to last five years ; total wages, 20,000,000f. For the Sarre-Moselle-Meuse canal : 600 German workers, with approximate total wages of 290,000,000f. For the Meuse-Schelde canal : 600 German workers, with approximate total wages of 205,000,000f. The scheme is being submitted to the Reparations Commission for its approval.

The Testing of Materials for Shipbuilding.*

By M. LEON GUILLET, Professor of Metallurgy at the Conservatoire National des Arts et Métiers and at the Ecole Centrale des Arts and Manufactures, Vice-president of the Société des Ingénieurs Civils de France.

INTRODUCTORY.

THE object of this paper is to draw the attention to a few points which are comparatively new regarding the methods of testing materials, more particularly materials employed in shipbuilding. This will be done very briefly and some reference will be made to earlier papers on the subject.

(1) TENSILE TEST.

This test always forms the basis of specifications. While it is easy to measure the breaking strength, the elongation and the structure, it is sometimes very difficult to obtain the elastic limit with any degree of accuracy. Many methods of obviating this difficulty have been evolved, but in practice not one is entirely satisfactory, and the Commission Permanente de Standardisation—French Standards Committee—which has its offices at the Ministère du Commerce et de l'Industrie Français, has had to be satisfied with the following method of verification :—The test piece is subjected to the load specified as the elastic limit, and on releasing the load after a certain time, no permanent set must have taken place.

The determination of the modulus of elasticity is a very delicate operation, and has to be carried out in a research laboratory. It is found from the results of all the tests which have been made that the modulus for steels is constant, whatever treatment is applied, its value lying between 18,000 and 20,000. This coefficient is not very often determined in practice. To-day when there is a very great variety of materials and a certain risk is often incurred in using them, this state of things cannot continue, and it would certainly be an advantage if the determination of the modulus were made less difficult. M. Guillery, who has already done much to simplify methods of testing, has just invented—see *Revue de Métallurgie*, February, 1922, "Mémoires," page 101—an extremely ingenious device which enables the modulus of elasticity to be obtained without difficulty—Fig. 1.

"This method consists of a cylinder and piston, the rod of which is attached to one of the jaws. The pressure is produced either by hand or by means of a belt, by two special high-efficiency pumps, one for quick action and the other for slow action with strong pressure. A reversing distributor enables the principal piston of the machine to be raised or lowered. On the bar are fixed, at a definite distance apart, two stops which can be rapidly fixed and removed, and the distance between them determines that part of the bar which is to be tested. The knife edges of two branches of the amplifier, a double-jointed parallelogram suspended to the frame of the machine, rest on these stops. One of the two horizontal branches of this jointed parallelogram carries a water chamber, one of the walls of which is formed by a metal plate with a rubber covering. In this way the chamber is made water-tight, and at the same time a certain degree of movement is possible, with a consequent variation of volume in the chamber. It is evident that the parallel movement of the stops causes no variation of volume in the chamber, but the difference in the distance between the stops causes a displacement magnified three times at the opposite side of the jointed parallelogram. The chamber is under pressure, and is connected by a rubber tube to a glass tube, the section of which, as compared to the surface of the movable wall, is such that the level of water in the glass tube drops two thousand times more rapidly than the elongations which are produced. Thus the elongations are shown on a greatly magnified scale by the fall of the water level in the glass tube. The pressures shown by the gauge are exerted on a frictionless piston which rests on a calibrated spring, the deflections of which are proportional to the loads. These deflections are transmitted to the movable wall of a second water chamber of the same type as the first, by a system of levers separated by a roller, the displacements of which allow of the movement transmitted being reduced or increased, and at the same time kept proportional to the deflections. But the arrangement is such that the loads when increased cause the level of the water to rise in the tube. Thus the loads are represented on a scale chosen by the operator by a rise of water in the glass tube. The second water chamber has another movable wall regulated by hand, so as to control the movement of the level of the water in the tube from a fixed reference point.

"It is therefore seen that, since by the displacement of the roller it is possible to cause a variation in the action of the loads, it is easy to find a position of the roller which will cause the loads to effect a rise in the level of the water equal to the distance it falls as a result of the elongations. Thus, if the modulus of elasticity is constant, a constant level during the period of elastic deformation is obtained, that is to say, the graphical representation of the test of the scale of the two movements in the tube will be, for this period, a straight line inclined at an angle of 45 deg. to the axes of the co-ordinates. The level will remain constant until the end of the proportional elongations, and its fall will be very easily observed, as the elongation is so greatly magnified. It is easy to see that the variable scale of the loads is an indication of the modulus of elasticity."

It is therefore sufficient to graduate one of the levers which transmit the stress ; a pointer fixed to the roller gives the value of the modulus of elasticity. The graduation is from 7000 to 30,000.

(2) FALLING WEIGHT TEST.

Falling weight tests on notched bars have become very common as a result of the war. In France the Charpy and the Guillery testing machines are very generally employed. It is known that very important publications have been issued setting out the conditions to be fulfilled in order that the results may be comparable. The Commission Permanente de Standardisation has specified the following method of procedure :—

"It is not necessary that the type of testing apparatus should be fixed, provided that the principle of measurement and the accuracy of the graduations have been verified beforehand. The following conditions, however, should be fulfilled by the test :—The bar shall rest on bearers, 40 mm. apart, and shall be very accurately placed before the blow is applied. The bearers shall have their upper surfaces rounded to a radius of 1 mm. A clearance in accordance with that shown in Fig. 2 shall be allowed in order to reduce friction at the extremities and to avoid the wedging of the bar. The knife edge fixed to the falling weight shall have a triangular section, the angle at the apex not being greater than 30 deg. The striking edge shall be rounded to a radius of 1 mm. It is absolutely necessary that the distance between the bearers shall be very frequently verified with a special template, and it is also necessary to ensure that the knife edge fixed to the falling weight is exactly in the middle of this distance. The position of the bar on the bearers must also be very carefully verified for each test with a special template, the position of the notch being taken into account. The speed of the blow shall not be less than 5 m. per second. Unless any figure is specially prescribed for the tempera-ture, it shall lie between 15 deg. and 20 deg. Cent. The influence of the temperature is much more marked than in any other method of testing."

The Commission Permanente de Standardisation has also drawn attention to a new test piece which combines the two types employed in France, that of M. Mesnager —55 mm. × 10 mm. × 10 mm., the notch 2 mm. × 2 mm. rounded at the bottom—and that of M. Charpy—55 mm. × 10 mm. × 10 mm.—the notch being formed by a cylindrical hole 1.3 mm. in diameter, tangential to the axis, opened out by a saw cut 1 mm. wide. The former test piece breaks with difficulty in the case of resilient metals ; the second often gives figures which are comprised within a very limited range. The dimensions of the new piece are 55 mm. × 10 mm. × 10 mm. The notch has a cylindrical base, having a radius of 1 mm. and a

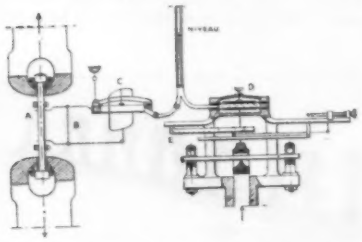


FIG. 1.—GUILLERY APPARATUS FOR ASCERTAINING THE ELASTIC LIMIT AND THE MODULUS OF ELASTICITY.

A. Test-piece. B. Double Articulated Parallelogram.
C. Water Chamber. D. Second Chamber.
E. Regulating Mechanism for Second Chamber.

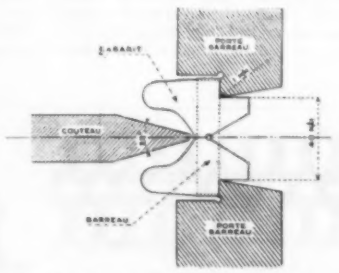


FIG. 2.—CONTROL OF SUPPORTS FOR SHOCK TESTS AND PLACING TEST-PIECE IN POSITION.

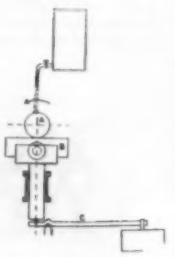


FIG. 4.—APPARATUS FOR WEARING TEST (JANNIN SYSTEM).

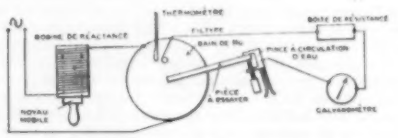


FIG. 5.—APPARATUS FOR THERMO-ELECTRIC TEST.

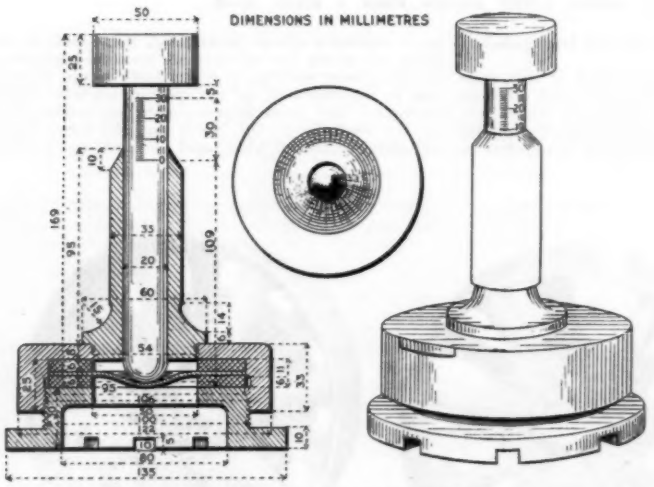


FIG. 3.—APPARATUS FOR PUNCHING TEST.

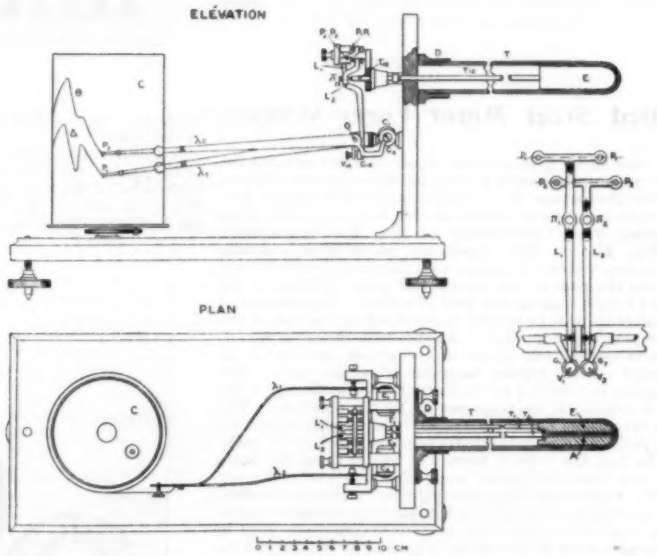


FIG. 6.—CHEVENARD SYSTEM OF THERMO-ANALYSIS TEST. SWAIN SC.

* Institution of Naval Architects, Paris Summer Meeting.

depth of 5 mm. It has been the subject of study in different quarters, but it has not yet come into general use, and it is too early to say if it will have the utility expected of it.

(3) Ball Hardness Test.

The ball hardness test is the only hardness test in current use. The sclerometer has not yet emerged from the region of research, and the scleroscope has practically fallen into disuse in France. The employment of the ball hardness test has increased to an even greater degree than that of the falling weight test as a result of the exigencies of the war. All works where heat treatment is applied employ the test, and it is also used to obtain the breaking strength of annealed material—the formula does not apply for hard drawn or hardened materials. It is known that—

$$R = C\,\Delta,$$

R being the breaking strength, Δ the Brinell figure ($\Delta = \frac{P}{a}$ P, the pressure applied, a the area of the spherical cap in mm.^{2}), C a constant for the same class of metals.

$C = 0.356$ for steel.
$C = 0.50$ for brass.

For ordinary cast iron the formula is a little less simple. It becomes—

$$R = 0.2\ \Delta - 13.$$

In regard to this test, the Commission Permanente de Standardisation has made the following recommendations :

"The wear and the sphericity of the ball must be frequently checked. It shall be brought into contact with the surface of the metal to be tested by a lever, piston or spring in such a way that the pressure increases gradually and uniformly. This condition is very important. It is necessary, moreover, that the testing apparatus should be arranged in such a way that the direction of pressure is at right angles to the surface of the object tested. The surface to be tested shall be filed, and preferably polished with fine emery paper, care being taken not to produce any superficial hardening. The maximum pressure shall be taken as 3000 kilos. for steel and 500 kilos. for copper and its alloys. Two diameters at right angles to each other shall be measured, preferably by means of a microscope with a measuring eye-piece, or some similar apparatus, and the average of the two measurements shall be taken. As the influence of the length of time during which the load is applied is very great, only tests for which the periods of application of the load have been exactly the same, shall be compared. When comparative tests only are made at different points on the same test piece or on different test pieces, the pressure may be applied for any length of time—the Artillery Specifications fix the time at 10 seconds. When the figure for the hardness is fixed and no length of time is specified for the application of the pressure, this time shall be 15 seconds. The calibration of the testing apparatus may be effected with specially prepared metal bars, on which impressions shall be successively made with the testing apparatus and with an apparatus taken as standard or with marked weights, the period of time being the same in both cases."

It is to be noted that M. Guillery has invented an apparatus which allows for rapid tests being made, the shortness of the duration of the test being compensated for by an increase in the load—*Revue de Métallurgie*, February, 1921, "Mémoires," page 101. Finally, it should be pointed out that the ball-falling weight tests are not generally employed in France. The *trousse de comparaison* described by Turpin and constructed by Morin—*Revue de Métallurgie*, February, 1915, page 104—is, however, fairly frequently used when approximate results only are required.

(4) Punching Test.

This test, which is of the greatest interest to manufacturers and users of sheet metal, has just been officially prescribed in the specification for sheet aluminium. As is well known, this test is as follows :—A punch of definite shape and dimensions punches the metal and the depth of the deflection is measured at the instant the breaking of the plate takes place. Fig. 3 reproduces one of the forms most frequently used and given in the official specification for sheet aluminium. Frémont, in a Note to Académie des Sciences—January 17th, 1922—has shown the inaccuracy of this method, as the moment of breaking may be wrongly judged. Thus, Frémont has shown that for sheet aluminium an inspector might record a value for the deflection varying between 3 mm. and 9 mm. Very justifiably Frémont comes to the conclusion that it is necessary to introduce a recording diagram and to limit the punching to the first yielding of the plate in the case of metal sheets selected for their rigidity. Moreover, Frémont advises a falling weight cupping test in the case of metal sheets used on account of their resiliency.

(5) Wearing Tests.

We know that the results of wearing tests are very uncertain, and also that the tests are very delicate and sometimes of exceedingly long duration. The Martens, Derihon and Amsler machines are not in general use on account of one or other of these reasons. A French engineer, M. Jannin, has constructed a very simple machine based on a new principle, which in a few minutes gives reliable results which can easily be expressed by a number—*Revue de Métallurgie*, February, 1922, "Mémoires," page 109—Fig. 4.

"Constructed for the purpose of determining the resistance to wear of the various metals used in the manufacture of journals and bearings, it allows of the determination of the influence of lubricating oil, of the polish of the journal, and of the hardness of the bearing upon the wear of these parts. The principle upon which this machine is based recalls somewhat that underlying the Brinell machine. It consists in producing an impression on a small tongue of metal at the end of a comparatively short space of time through the friction of a revolving journal. This impression is sufficiently well defined to allow of its being measured and compared with other impressions produced under the same conditions. The machine—Fig. 4—is composed of a horizontal spindle revolving at a uniform speed. On this spindle is mounted a journal, if a bearing metal is to be tested, or a roller A, if metal for the manufacture of shafts. Above the journal or roller a small vice fixes the tongue of metal B on which the wear is to be measured. This vice is mounted on the beam C of a steelyard, in such a way as to cause the metal tongue to exert a constant pressure on the journal. The journal is adequately oiled during the test by means of an oil reservoir placed above it. The duration of the tests is generally fixed at 5 minutes for the test on bearings and 15 minutes for the test on shafts. If it is desired to make a thorough study of the various influences affecting the wear, the test must last for an hour or two. The wear depends on the following five variable factors :—The material of the journal, its hardness, its degree of polish, the material forming the metal tongue, and the nature of the lubricant. It is evident that if four of these variable factors are maintained constant, the influence of the fifth can be determined."

(6) Alternative Tests.

These tests relate almost exclusively to the materials of moving parts. It is, however, desirable to call attention to the conclusions to be drawn from several definite results obtained with the well-known Cambridge machine in which repeated blows are directed on a test piece rotating about its axis. Systematic tests carried out on different materials, ordinary and special steels, brass, aluminium bronzes, light alloys and especially materials and alloys of identical composition, which have undergone different mechanical treatment, prove the great importance of the limit of elasticity from the point of view of resistance to these repeated light blows—Guillet, *Revue de Métallurgie*, February, 1921, "Mémoires," page 96, and December, 1921, "Mémoires," page 755. It is evident that too much attention is given to the question of high resiliency, and that in consequence a lowering of the elastic limit is too readily permitted, although the latter has a very important effect on the wear of parts, the majority of parts requiring only a moderately high tensile strength—12 kilos. to 15 kilos. per square centimetre.

Macrography.

Macrographic investigation is not yet generally used as a method of testing. This is a serious mistake. It ought to be very widely employed, and be looked upon as a workshop method. It requires neither the very special apparatus of micrography, nor unusual care in the preparation of test pieces, nor even specialised knowledge for the interpretation of the results. Amongst these results must be cited segregation, heterogeneity, the existence of blow-holes, more especially in metallurgical materials. The iodo-iodide reagent of Frémont, the methods of recording on photographic bromide paper the presence of sulphur and phosphorus, the Stead-Le Chatelier or copper chlorides reagent are worthy of the attention of all those who use blast-furnace products. Macrography allows of the detection in a very rapid and simple manner of very important and common defects.

Physical Tests.

Hitherto physical tests have been regarded as delicate laboratory operations. We should like to call attention to two of these tests which may be very effective in certain cases. M. Galibourg has recently shown—Reports of the Académie des Sciences, February 6th, 1921—all the advantages which can be derived from thermo-electricity. Two steels may present practically the same degree of Brinell hardness, although differing materially in composition, the one, for example, containing 0.3 per cent. C and 3 per cent. Ni, the other 0.1 per cent. C and 6 per cent. Ni. A thermo-electric investigation permits of these two steels being differentiated by comparison with a standard metal, a mercury bath, slightly heated, very rapidly ensuring contact between the material to be tested and the standard metal, and the current passing through a galvanometer—Fig. 5.

Chevenard has constructed a new dilatometer, which is very strong and can be safely handled by anyone. By means of this dilatometer the points of transformation can be found, and it is thus possible to identify the different casts, at least for special steels. For this purpose the metal under test is bored in the centre and placed in a heated silica tube—Fig. 6—*Revue de Métallurgie*, January, 1922, "Mémoires," page 39. A needle of an alloy—pyros—following a known and regular law of expansion, is placed in the central hole. One rod of silica rests on the pyros and a second on the metal itself. The movement is magnified by levers and finally the curve of the temperatures and also the curve of the expansions of the metal are registered on a cylinder rotating at a uniform rate. The irregularities are noted, and by comparing them with the first curve the position of the points of transformation is known.

Conclusions.

This paper has been intentionally limited to an account of the most recent methods of testing, excluding those methods which come purely within the region of research work. It will be seen that the user of metallurgical materials has within his grasp all that is necessary in order to obtain quick and accurate information regarding their value.

MANUFACTURE OF PIG IRON IN NEW ZEALAND.

According to the *Dominion* (New Zealand) of May 4th, the first tapping of the blast-furnace at Onakaka took place on April 27th. This furnace was erected by the Onakaka Iron and Steel Company, Limited, which was formed for the purpose of developing a part of the extensive iron ore deposits of Golden Bay. The company, which has installed a modern plant for the production of pig iron, has its own supplies of coal, iron ore and limestone, and it is able to get the ore and the limestone in an open quarry opened out not far from the furnace. The furnace is now, it is reported, running smoothly, no difficulties being encountered, and is tapped about every eight hours. As the furnace settles down to work, about 8 to 10 tons of pig iron per tap will be produced. The expert in charge is reported to be well satisfied, and to say that the iron produced is all that could be desired, and quite up to the high quality anticipated. It is the expressed intention of the company to produce 100 to 150 tons of iron, so as thoroughly to test all the units connected with the plant. It will then close down temporarily, pending the completion of the coking ovens and railway of 1¼ miles to the wharf. With their completion in a few months' time the linking up of all the necessary raw materials, iron ore, limestone, water and coal with the works and the market will be complete, and the furnace will then be permanently put into commission. The cost of raw material for the manufacture of iron at Onakaka is given as follows :—Cost per ton of iron at the furnace, including royalty, labour and carriage : Iron ore 12s., limestone 3s., coke 40s., total £2 15s. Labour is not more than 15s. It is estimated that coal from the company's mine, when opened up, will not cost more than 15s., including royalties, at the works.

Catalogues.

W. H. Dorman and Co., Limited, Stafford.—A copy of the latest "Flexstel" booklet.

Higgs Brothers, Sand Pits, Birmingham.—The June issue of this firm's monthly magazine.

The Stanton Ironworks Company, Limited, near Nottingham.—Monthly list of cast iron pipes in stock.

Fry's (London), Limited, 46, Upper Thames-street, E.C. 4.—Copy of the firm's 1922 hacksaw blade catalogue.

Meldrums, Limited, Timperley, near Manchester.—Several additional sheets of the firm's forced draught furnace list have been received.

Paterson Hughes Engineering Company, Limited, 36, Charlotte-lane, Glasgow.—List No. 5, describing the "Clyde" screw pile-driving machine.

Andrew Barclay, Sons and Co., Limited, Caledonia Works, Kilmarnock.—Catalogue of locomotives, specially intended for working on light and poorly ballasted rails.

The Butler Machine Tool Company, Limited, Victoria Ironworks, Halifax, England.—Illustrated pamphlet describing "Butler" improved high-speed planing machines.

C. B. Wardman and Co., Limited, 122, Great Portland-street, London, W. 1.—A pamphlet, entitled "One Hundred Years of Engineering Behind the Ruston-Hornsby Car."

Ateliers de Constructions Electriques de Charleroi, Belgium, 56, Victoria-street, S.W. 1.—Illustrated pamphlet dealing with motor converters manufactured under the La Cour patents.

The Consolidated Pneumatic Tool Company, Limited, Egyptian House, 170, Piccadilly, W. 1.—Circular No. 78, containing an illustrated description of the firm's electric rivet heater.

Clayton Wagons, Limited, Lincoln.—Pamphlet concerned with electric road vehicles of from 2 to 6 tons capacity. Also illustrated pamphlet discussing the firm's overtype steam motor wagons.

Siemens Brothers and Co., Limited, Caxton House, S.W. 1.—Supplement I. to Catalogue 600 on primary cells and batteries, dry and fluid, for the high-tension circuit of wireless apparatus using thermionic valves.

Ronald Trist and Co., Limited, 12, Clipstone-street, W. 1.—A reprint of Mr. E. L. Samson's paper on "Sand Blasting," which he read before the Institution of British Foundrymen (London Branch) in February last.

Clayton and Shuttleworth, Limited, Lincoln.—Illustrated pamphlet on "Clayton" water-tube boilers, in units up to 100,000 lb. per hour evaporation ; also publication No. 321 on "Clayton" crude oil engines (illustrated).

Herbert Morris, Limited, Loughborough.—This firm has just issued a new Spanish booklet—No. 86—which contains a brief review of the range of its manufactures. The title of the book is "Indice Ilustrado de las Manufacturas Morris."

The Relay Automatic Telephone Company, Limited, Marconi House, Strand, W.C. 2.—Booklet on "Pointers on British Automatic Telephony," containing an illustrated description of an inter-departmental automatic telephone system.

C. A. Parsons and Co., Limited, Heaton Works, Newcastle-on-Tyne.—Wall calendar, with monthly cards. A working model has been embodied in the calendar representing a sectional view of a group of end-tightened reaction blading.

Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.—New folder on Shurvent fuses. Pamphlet dealing with the Shurvent protection for low-voltage circuits up to 600 volts, both alternating and direct current.

A. A. Jones and Shipman, Limited, New Century Machine Tool Works, Leicester.—A new brochure has been issued by this company, the subject being precision grinding machines. Illustrations of the tools manufactured by the firm are included with the descriptive matter.

Samuel Osborn and Co., Limited, Clyde Steel Works, Sheffield.—Booklet No. 3 on "Titan" manganese steel tramway and railway track work manufactured by the Titan Trackwork Company, Limited, Rutland-road, Sheffield, an associate company of Messrs. Samuel Osborn.

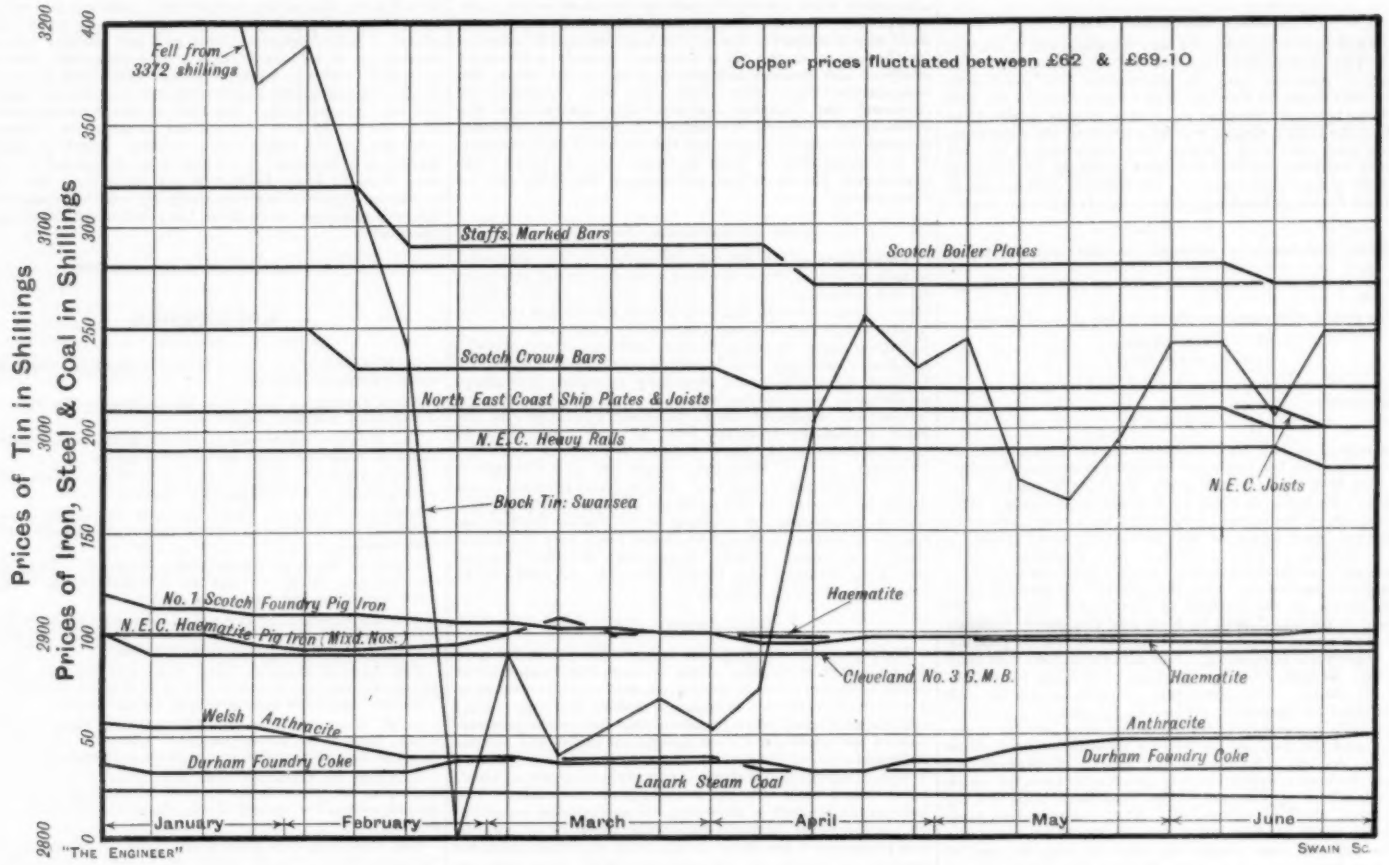
The English Electric Company, Limited, Queen's House, Kingsway, W.C. 2.—The Fullagar oil engine for land purposes is described in a new pamphlet just received. Pamphlets on the English Electric cylindrical balanced valve, relief valve, and bucket attachment for impulse wheels.

Marshall, Sons and Co., Limited, Gainsborough.—Publication No. 1251, which gives a description with illustrations of "Marshall" road rollers. Section No. 14, Publication No. 1270, deals with "Marshall" horizontal and vertical steam engines of the simple slide valve type.

The Edison Swan Electric Company, Limited, Ponders End, Middlesex. The following leaflets have been received :—IN 252/5, Moving Coil Switchboard Type Instruments Specification ; /6, Moving Coil Switchboard Type Instruments, Circular Pattern ; /40, Portable Combined Testing Set ; /73, Insulation Testing Set ; /77, Moving Coil Type Cell Testers ; /79, Galvanometers Linesman's Detectors without Batteries ; /105, Moving Iron Instruments for Direct or Alternating Currents ; /106, Moving Iron Switchboard Type Instruments, Circular Pattern.

Adam Hilger, Limited, 75a, Camden-road, London, N.W. 1.—Leaflet on the Hilger chemical spectrometer. This apparatus has been designed for chemical analysis. An illustrated descriptive catalogue, entitled "A New Road to Good Annealing, including the Twyman Annealing Indicator and Annealing Recorder, with the Hilger Strain-viewer." Pamphlet on Professor Coker's apparatus for determining the distribution of stress in structural and machine members. Also pamphlet dealing with the Hilger optical sonometer, an apparatus which has been designed to record the pressure variation caused by sound waves.

PRICES OF ENGINEERING MATERIALS DURING THE FIRST HALF OF 1922



The prices are all given in shillings. It should be noted that a separate zero is given for tin. The horizontal divisions are weeks, taken from Friday, January 6th, to Friday, June 30th. In the case of coals the prices are those quoted for export, as it is practically impossible to give market prices for industrial consumption at home. Thus in South Wales the prices for inland consumption are sometimes 2s. per ton above, and at other times as much below, export prices. In Scotland the pithead price is generally some 2s. below the f.o.b. price, but carriage costs from 4s. to 7s. 6d. according to the distance. In the Midlands home prices are generally from 2s. 6d. to 4s. per ton less than those for export, for such classes as are exported.

A Quarter's Shipbuilding.

FROM Lloyd's Register shipbuilding returns for the quarter ended June 30th last, which have just been published, it appears that the merchant tonnage returned as under construction in the United Kingdom at the end of June, 1922, amounted to 1,919,504 tons. This represents a reduction of about 316,000 tons as compared with the total at the end of the previous quarter; but under the present conditions even these reduced figures cannot be regarded as a true index of the activity of the shipbuilding industry in the near future. The total includes a considerable amount of tonnage—481,000 tons—on which work has been suspended for some time. Deducting this amount in order to enable a comparison to be made with figures for normal times, the tonnage actually under construction in the United Kingdom now amounts to 1,439,000 tons. The average tonnage under construction during the twelve months immediately preceding the war was 1,890,000 tons, *i.e.*, 451,000 tons more than the present figures.

As compared with the figures for the quarter ended March 31st last there has been a considerable reduction in the tonnage launched and in the tonnage commenced in the United Kingdom during the past quarter, the tonnage of vessels launched being 185,000 tons, and of those commenced 12,000 tons less. The total merchant tonnage being built abroad is 1,315,926 tons, but that figure includes about 290,000 tons upon which work has been suspended, leaving about 1,026,000 tons actually under construction. In fact, the tonnage being built abroad is about 128,000 tons lower than the total under construction at the end of March. The decrease affects most countries, but specially France, Holland, and Italy. The figures for the leading countries abroad are:—Italy, 285,071 tons; France, 243,290 tons; Holland, 226,318 tons; United States, 150,023 tons; and Japan, 115,512 tons. These figures do not take into account the tonnage being built in Germany and at Danzig, for which no returns are available, but it is estimated that the tonnage under construction in Germany at the present time is about 500,000 tons, and at Danzig 45,000 tons, as compared with a total of 547,000 tons in June, 1914.

As regards the tonnage of vessels launched in the world during the quarter under review, the total is given as being 389,760, of which 148,886 tons were launched in the United Kingdom and 240,874 tons abroad. In addition to the above, about 150,000 tons were launched in Germany, but, as previously stated, these figures are only approximate. The tonnage commenced during the same period amounted to 150,822 tons, of which only 38,877 tons were commenced in the United Kingdom.

The returns show that there are at the present time 82 steamers and motor vessels, each of over 1000 tons, with a total tonnage of 529,911 tons, under construction in the world for the carriage of oil in bulk. Of the total, 60 of 383,221 tons are under construction in the United Kingdom. The tonnage of vessels now building which are to be fitted with internal combustion engines amounts to 251,328 tons.

Of the total tonnage under construction in the world—which total excludes vessels the construction of which has not actually been commenced and also all vessels of less than 100 tons—2,010,912 tons are under the inspection of the Society's surveyors, with a view to classification in Lloyd's Register Book.

American Flue Dust Sintering Plant

A SINTERING plant for dealing with the flue dust of the Cambria Steel Company, and having a producing capacity of 1000 tons daily, has been built at Johnstown, U.S.A., by the Arthur G. McKee Company, under the Dwight and Lloyd patents. Mechanical apparatus is used so completely that only about twelve men are required in the works. The railway lines on which the raw material is delivered are about 40ft. higher than those on which the product is delivered, the plant being built on sloping ground to facilitate gravity movement through the several processes.

Flue dust from the furnaces or stock piles is delivered in large drop-bottom railway wagons to two unloading hoppers, 30ft. square, each accommodating four wagons. These hoppers are covered with cast iron gratings, having openings 4in. by 5in., in order to exclude large objects and foreign matter, and also to provide for the safety of workmen. Through an adjustable discharge gate the dust flows from the hopper upon a continuous steel pan conveyor, 60ft. long, which is inclined upward about 25 deg., and discharges into two revolving screens, which are hexagonal in section and 12ft. long, with a diameter of 6ft. at one end tapering to 4ft. at the other end. The screen panels are renewable.

Four storage bins have a total capacity for 640 tons of dust, which is sufficient to supply the sintering machines for fourteen hours. Thus the unloading and screening plant works only a ten-hour turn daily. From the bottom of each bin a revolving disc feeder, with adjustable gate, delivers the dust to a series of belt conveyors, which discharge into a hopper serving as a receiver or reservoir to supply two sintering units. Power-operated feeders cause the material from the hopper to fall into a pug mill, which consists of a cast iron trough, 12ft. long, in which run two shafts fitted with manganese paddles or blades. The shafts revolve in opposite directions. Here water is added to bring the mixture to the desired consistency. This mixture is spread evenly on the hearth of the sintering machine by means of a swinging spout which is moved to and fro by a rope and counterweight attached to a crank on a countershaft of the sintering machine.

This machine consists of an endless train of pallets travelling under ignition burners and over wind boxes fitted with down-draught suction fans. The effective grate area is 3½ft. wide and 57½ft. long. The pallets are separate, but are driven by sprockets at both ends of the run, the frame of the pallet being formed with a rack to engage the sprockets. The wheels of the pallets have oil chambers and are fitted with renewable steel bushings. Air-tight joints between the pallets and the wind boxes are maintained by sealing bars, which fit in finished slots in the sides of the pallets and bear upon the finished surfaces of the tops of the wind boxes.

A gas burner is used for the ignition, making a flame of sufficient intensity to ignite the entire surface of the charge positively, but not to dry it completely, as premature drying retards the sintering action. Motor-driven fans maintain a suction of 20in. of water at the wind boxes and discharge the hot gases through underground flues to a large chimney.

The pallets move at a speed of 60in. to 90in. per minute, and at the end of the upper travel each pallet drops down a curved track, thus discharging its load on to a screen. Each falling pallet strikes the one ahead of it, thus ensuring complete discharge. The screen, set at an angle of 30 deg., is 5ft. by 12ft., with bars spaced ¾in. apart. The finer sinter, which passes through the screen, is delivered by gravity into railway wagons. About 25 to 30 per cent. of the materiel is retained by the screen, and falls upon a pan conveyor, which returns it to the mixing end of the plant. This coarse material is desirable in the flue dust mixture, as it improves the sintering action. As this rejected material from the screen is sometimes red hot and has to be cooled with water, the conveyor is subjected to severe operating conditions. From this pan conveyor the material is delivered to inclined belt conveyors, which carry it up to two 160-ton storage bins in line with the flue dust bins.

Dust carried down from the sintering machine is conveyed by the fan draught through a dust chamber fitted with steel collecting bins. In these the dust settles, and is thus removed before the air current reaches the fans. At intervals, gates are opened, allowing the dust to fall on to a belt conveyor, which delivers it to the pan conveyor carrying the rejections from the sinter screen.

IN an interesting article on "Old English Windmills," in the *Architect*, Mr. J. C. Kershaw says that quite a large number of the windmills still working in England have but two sails or sweeps, having lost two by decay or gales; and the high price of timber and labour during the last few years has often prevented their renewal. Yet several millers assert that they do more work in proportion than with the proper complement of four sweeps, though they do not run so steadily. The reason they give is that with only two sweeps there is much greater area for the wind to escape behind the sails after having expended its useful energy, and consequently there is, so to speak, less "back" pressure. Perhaps this is one reason why the steel-wheel windmill, with almost its whole area filled with vanes is not so efficient in utilising wind pressure as the oldf our-sailer. The former is cheaper and lighter; otherwise it appears to be a retrograde step in the scientific production of power from wind, and is certainly substituting an ugly machine for a highly picturesque structure. The author also describes how a millwright, in converting an old mill, bored a hole down the length of the cast iron sail shaft, a distance of some 12ft., by rigging up a drill at the back and letting the mill revolve itself. The hole was nowhere more than ¼in. out of truth.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Midsummer Quarter Day.

THE midsummer Midland iron trade quarterly meeting this week has been disappointing. The attendance, which embraced iron and steel men from all parts of the kingdom, deserved a better result; but to be honest, the meeting proved tame, and a good number of people perhaps would be disposed to vote it only a poor affair. That a more hopeful construction is put upon the trade situation generally may be deduced from the firming up of pig iron, but it must be confessed that tangible evidences of a quickened demand are not easy to find, except in one or two departments of no general significance. The more favourable tone which has latterly developed in pig iron was maintained on the market at Birmingham yesterday —Thursday—but no more. Some of the furnace owners have experienced a little improvement in demand, especially welcome in the forge iron department, as the result of the re-starting of some Staffordshire forges and mills after a long period of idleness, but the improvement is not at all large, and prices, though stronger, cannot be said to be quotably advanced. However, one of the blast-furnaces which has been standing idle in North Staffordshire has been re-started, a pretty good indication that the stagnation is passing, and the quarterly meeting certainly hoped that more Staffordshire blast-furnaces would be going in shortly. The unremunerative character of business was generally complained of on the Exchange, ironmasters, both pig and manufactured, stating that present prices in several directions hardly covered the cost of production. It is recognised that iron prices cannot remain at the present level, but it has been felt that there ought to be a pause during which the trade could recuperate, while the fall in production costs was catching up with the collapse of selling prices, so that the deflation movement might be completed on economic principles.

Finished Iron at the Quarterly Meeting.

As for finished iron, interest at the quarterly meeting was centred chiefly in the demand for fencing and nut and bolt bars. Orders have been growing since the lock-out ended, some of the biggest going to Lancashire mills, which have made full use of the freedom given to them by the suspension of price restrictions. Business has been done round about £10, £9 17s. 6d. being accepted for nut and bolt qualities when attractive orders were at stake. These prices still rule, with half-a-crown more asked for fencing iron. The time required for delivery on Continental consignments is a barrier to any great extension of the import trade, though purchases can be negotiated at £8 17s. 6d. delivered in the Black Country. Manufacturers prefer to buy their raw material where they can get supplies straightaway. This is, indeed an essential condition of trade as it is now carried on, when the keeping of stocks down to the very barest necessity governs the policy. As demand becomes more regular and consumers can look further ahead they will certainly have increasing recourse to these cheap continental sources of supply unless the home maker is able to cut down the price difference to something a good deal less than £1. A few puddled bars are now being bought abroad. It is very interesting to compare to-day's prices with those which ruled at the opening of the year or on the occasion of the January quarterly meeting in Birmingham. Prior to the January quarterly meeting for a considerable number of weeks the nominal standard of unmarked or merchant bars of £13 exhibited a number of downward graduations until the minimum was touched in the middle of January at £12 and £12 5s. per ton. Then, as now, the underselling was not only in this district, but more especially from Lancashire, which offered bars at as low as £11 15s. per ton. The County Palatine had for some time led the way in reductions, the view in that district at the beginning of the year being that, at whatever cost, rock bottom level must be reached as quickly as possible. An attempt to evolve order out of the then existing chaos, so far as Staffordshire was concerned, was made a week before January by an important meeting of the bar iron makers. Strange to say, however, the meeting decided against any reduction, a decision which accentuated the previously widely entertained doubt of the efficacy of the Staffordshire Bar Iron Association, which was unable to control prices, with the result that there were last January a good many defections from the membership of the Association. The official declaration of £13 for unmarked Staffordshire bars last January had very little practical application; unassociated mills accepted from 10s. to 15s. less, and, as I have already intimated, some firms openly quoted as low as £12. Staffordshire marked bars at that date were re-declared at £16 per ton, which compares with to-day's price of £13 10s., so that in the past six months there has been a drop in the price of best Staffordshire bar iron of 50s. Merchant or Crown bar iron was selling this week at between £10 15s. and £11, and for superior makes up to £11 5s. per ton.

The Economic Factor in the Iron Trade.

The Midland and Staffordshire iron market at the present time is really difficulty to read. A period has been reached when producers think the economic factor should again rule. Some among them are still prepared, in the absence of any adequate demand, to lower prices rather than allow their plants to go idle, while others are reluctant to withdraw from the struggle for business, even though their immediate losses may be increased by holding on. A certain number of local ironmasters have, however, definitely come to the conclusion that the hoped-for stimulus must be sought in a re-establishment of confidence rather than doping the market with price reductions which have no relation to production costs, and which really mean cut-throat competition for a volume of business which is not enough to go round. They are persuaded that the continual shifting of prices is encouraging prospective buyers in postponing business, believing that they are curtailing production rather than competing for orders on those terms.

Pig Iron Now and Then.

An extraordinary resemblance is presented by Staffordshire and Midland pig iron to-day compared with how matters were looking at the opening of the year. This fact will be immediately recognised when I state that in the middle of last January I reported that no further progress had then been made in South Staffordshire towards the re-starting of blast-furnaces, and that the furnaces operating were unable to dispose of the whole of their output. The Staffordshire smelters even as long ago as last January had decided that with a very poor demand and heavy productive costs, especially under the head of railway rates, the outlook was discouraging. There was practically no demand for forge material, and foundry sorts were called for only in small quantities. One local smelter at this time estimated that the demand was about 12½ per cent. of the normal. Northamptonshire forge iron was selling at that date at £3 17s. 6d. at the furnaces, and foundry iron at £4 7s. 6d. Derbyshire No. 3 foundry iron was quoted at £4 10s. and forge iron at £4. At this week's quarterly meeting prices were as follows:—Northamptonshire forge iron, £3 10s. to £3 12s. 6d.; foundry, £4; Derbyshire forge, £3 12s. 6d. to £3 15s; and No. 3 foundry iron, £4 2s. 6d.—all at furnaces. The announcement that ironmasters had decided to discontinue fixing prices of Cleveland iron, and that firms had once more a free hand as to prices, was welcome to those on 'Change.

Steel.

A remarkable incident in the steel market last January in Birmingham, which is now well worth recalling, was that for the first time for something like two years, American billets were being sent on to the Midland market. They were offered at a price which was tempting to consumers near the ports, but the extra cost of carriage to the Midlands put them largely out of court here. Staffordshire quotations at this time varied from £7 15s. to £8. A large Staffordshire firm had reduced its quotation for billets from £8 to £7 15s. The motive in this case did not appear to be foreign competition, but the keen rivalry of English firms for such business as was obtainable. To-day steel is quiet in practically every branch. The recent quotation of £7 15s. for South Wales billets and sheet bars in the Birmingham area no longer applies even nominally. Sellers are at liberty to take the best price they can get. Foreign competition has been effectually curbed, however, by Midland producers. Continental shippers of half products now want about £6 10s. for delivery at British ports, and this is a price which gives them little chance in free competition, for billets can now be bought here at £7 5s. to £7 7s. 6d., and even less has been taken. Galvanised sheets to-day of 24 w.g. rolled from these same billets are quoted at £16 per ton easy f.o.b. Liverpool, compared with £16 10s., which was the price when the year opened.

The Engineering Trade War Bonus.

Midland master engineers are hopeful that the result of the ballot on the proposal that the war bonus at present paid to their employees should be reduced by 16s. 6d. per week in three instalments of 5s. 6d. will be favourable. It is held that production costs must be reduced if there is to be any revival of the market for engineering goods. If the employers' proposal is accepted the war bonus in the industry after September 25th will be 10s. per week.

A Government Subsidy Wanted.

Warwickshire miners are again agitating for a Government subsidy. It is recognised that the coal mining industry is in a sad plight, and it has been pointed out to them that the profits of the industry have fallen so much that at the present moment, if the total proceeds of the industry, apart from the cost of production, were added to wages, the men would not have what their leaders consider a decent wage. The Warwickshire miners, who are, by the way, not so badly off as those in other regions, are of opinion that they could make out a good case in the name of national economy for a subsidy from the Government to help to put the industry on its feet.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

General Outlook.

THERE are reports from many sides that some improvement in the markets is visible, but one cannot see any signs of this hopeful anticipation on the Manchester markets. Some people do not yet seem to realise that British prosperity and trade revival depend upon export trade, and that export trade depends very largely upon stability in foreign exchanges. With the German mark threatening to become about as stable a currency as the Russian rouble, German trade may yet go the way of Russian trade, and more than half Europe may be involved in commercial ruin. This does not seem a very good preliminary to the revival of British industries.

Metals.

In the copper market the fluctuations have been very small, but it may be safely said that things are no worse than they were. The demand in the Manchester district does not show much improvement yet, and so far as the engineering industry is concerned there is very little buying of copper. The price in the speculative market for standard copper is a little higher than it was, but consumers' copper, such as best select and electrolytic ingot is practically unchanged. The American market is steady, but it is not yet easy to see what will be the effect of the railway strike in that country. It is, however, not very probable that American copper prices can go back very far. The demand from Germany is checked by the vagaries of the exchange, but this may be only temporary. So long as people will supply Germany with things of real value against paper, which may soon be of no value at all, Germany will go on buying. What revival there is in the engineering trades of this country seems mainly confined to the making of textile machinery. Firms specialising in this class of work have a great deal to do, more particularly in spinning machinery; but this work does not involve any very large consumption of the non-ferrous metals. To increase the consumption of these metals we need to extend the revival to general engineering. There is also a need for revival in the brass trade, for at present the consumption of copper by the brass manufacturers of Great Britain is very small. Perhaps a fairly good idea of the state of trade in the non-ferrous metals is to be obtained from the prices offered by dealers in old metals. These do not show any advance, and remain from £10 to £15 per ton below the intrinsic values as compared with the markets for the new metals. Thus for clean scrap copper dealers offer about £50, and for gun-metal about £40 per ton. In the market for tin there is very little definite change to note. Buyers are curiously suspicious about the position of tin. It is, of course, known that there are fairly large supplies knocking about somewhere, but they do not appear, and there is no doubt that tin is being held very strongly. There is not much change yet in the position of lead, except that the backwardation for forward delivery is diminishing. The spot market is quite firm for foreign lead, but English metal has been a little easier. The prices for spelter are about as they were, but there seems to be a slight improvement in the demand from consumers. There is not much forward buying, and users of spelter are still maintaining the policy of hand-to-mouth buying. Small quantities of spelter come in from the Continent, but there are no large exportations, and apparently the consumption is rather in excess of the supply. Evidently consumers do not expect any rise in the price, and yet the circumstances seem favourable for it.

Pig Iron.

The Manchester market for foundry iron remains rather dull, but there has been no change in the prices, and probably this will be postponed until more furnaces come into competition for the Manchester and South Lancashire trade. At present the small number of furnaces operating in Derbyshire practically have this trade to themselves, and the price for No. 3 iron at these furnaces is 82s. 6d. per ton—or 7s. 6d. less than the price at the Cleveland furnaces for similar quality of iron. There is the question of the railway rates. The reduction may be enough to bring Northamptonshire pig iron again into this district, but it can scarcely bring in Cleveland iron until the furnace price of that make is reduced. This would seem to depend upon whether the export demand keeps up. At present the export demand is strengthened by the buying from America, but, of course, this is a temporary phase, although it may last until the American coal strike comes to an end. Hematite pig iron is again weaker, and East Coast brands have been sold at only 2s. per ton more than the price of common iron in that district. Scotch iron keeps steady, and there is a fair demand for it in Manchester and the towns which make cotton machinery.

Finished Iron and Steel.

The market here for manufactured material is dull and lifeless. Steel makers complain that all their business is done at a serious loss; and if this is not fully believed, yet it is obvious that profits must be very meagre. Probably the remedy will have to be found in reducing the costs of production, for there seems to be little chance of any rise in prices. Just now it seems quite possible that an attempt will be made to sell continental iron and steel in this country, which business may be facilitated by the fall in the exchange.

Scrap.

Sellers of foundry scrap here still quote 80s. per ton for good broken machinery iron, but the founders are not large buyers at present, and the condition of the market is decidedly weak. There is keen competition for the few orders which are about, and it is possible that less than 80s. would be taken by some of the dealers. Textile machinery scrap is dearer, and sellers ask from 85s. to 90s. for it; but there does not seem to be a very good demand, although textile engineers are the only busy section of the engineering industry. Wrought scrap is not very plentiful at 70s. delivered. Steel scrap is still very much neglected.

Institution of Mechanical Engineers—North-Western Branch.

In connection with the North-Western branch of the Institution of Mechanical Engineers two very enjoyable functions have recently been held. The first, on June 28th, consisted of a visit of inspection to the railway wheel and axle works of Messrs. Taylor Bros., Trafford Park, Manchester, and the second, on Saturday last, was a garden party, to which ladies were also invited, at the residence of Mr. James Dronsfield, Norley Hall, near Frodsham, Cheshire. At the former the party was divided into groups and conducted through the various departments of the works from the stockyard, *viâ* the steel melting stage, the ingot-slicing shop, tire forge, millwright's shop, through the engine and boiler-houses—where oil fuel was being used—to the wheel machine shops. The plant employed was generally much admired, and especially the machinery for handling and transporting the wheel discs and tires during and between the various operations. An idea of the expedition with which the work is carried out can be gathered from the fact that the works are capable of turning out 800 complete sets of wheels, tires and axles per week, apart from the disc centres. At the close of the visit Mr. Daniel Adamson expressed the pleasure which the members had experienced in being shown over such an up-to-date and progressive works, and thanked Messrs. Taylor Brothers, on behalf of the North-Western Branch, for affording them such an enjoyable afternoon and for their hospitable treatment. Mr. L. Hood, in his reply, mentioned that it afforded his directors

great pleasure that the North-Western Branch of the Institution of Mechanical Engineers should select their works for one of their visits, and informed the members that it was their intention to keep abreast of the times, and that he would be pleased to see them again. Although the weather did its worst to mar the pleasure of the party which motored out to Norley Hall, it did not succeed in damping the spirits of those who "braved the elements." In the beautiful grounds of this old-world Cheshire mansion a marquee had been erected where the visitors were hospitably entertained, while a band discoursed music. A vote of thanks to Mr. Dronsfield for his kindness was proposed by Mr. Charles Day, the chairman, and Mr. Dronsfield, in reply, said it gave both his wife and himself much pleasure in having the members of the Institution as their guests.

Salford's New Power Station.

At the last meeting of the Salford Council the proceedings of the Electricity Committee, which included the acceptance of tenders for the supply of electric generating plant at a cost of £178,734, and for six water-tube boilers at a cost of £132,660, were approved. The contract for the former was let to Metropolitan-Vickers Electrical Company, Limited, and for the latter to Babcock and Wilcox, Limited. The generating plant will comprise three turbo-generators of 10,000 to 12,500 kilowatts capacity. In each case borrowing powers have to be obtained from the Electricity Commissioners, and provision is made for a variable price clause in respect of wages. Councillor Billington, chairman of the Electricity Committee, said that the contracts of the Committee must be placed before July 15th in order to receive the Government grants. In response to advertisements only eight firms had tendered for the whole of their requirements. The Committee had gone carefully into the details, and they had regarded efficiency as the most important factor. They found that two of the firms tendering were not in this country, and they realised that they would by giving them the contract lose the grant for finding work for the unemployed. They decided that the tender which the Council was recommended to accept was the best in their interests. It was stated that one of the foreign firms tendered at £40,000 less than the tender which the Committee accepted; but the tenders had been considered on their merits and not simply as a matter of price.

Manchester Waterworks.

In the quarter ending March last the expenditure of the Manchester Waterworks Committee amounted to £189,605, made up as follows:—New mains and pipes, £36,794; Thirlmere works, £9280; Thirlmere (fourth pipe), £8457; Heaton Park reservoir, £10,685; Haweswater (including interest), £30,299; hydraulic power, £12,764; purchase of North Cheshire water undertaking, £81,326. The annual report states that the total area supplied with water is about 169 square miles, containing a population of about 1,500,000. The consumption showed a decrease on the figures for the previous year, the average per day being 48,678,142 gallons, as against 57,532,035 gallons in 1920–21. Preliminary surveys have been made for the construction of an additional high-service reservoir to meet the growing demand in the higher parts of Blackley, Moston, and Prestwich.

BARROW-IN-FURNESS, Thursday.

Hematites.

The state of the hematite iron trade is by no means brisk yet, and the expected improvement in consequence of the settlement of the engineering labour troubles has not brought any development to speak of. Many of the makers of iron had kept their furnaces running in the hope of an improvement, but the stocks have been increasing, and as a result one of the furnaces at Ulverston has been damped down for the time being. This is not real evidence of poor trade, but is simply an act of protection against increasing stocks at the works. The amount of trade with Scotland is meagre, and there is at the moment not much life in any particular district as far as business is concerned. The Continent is inquiring, but the tonnage is not very great. The steel works are taking a certain amount of iron each week, and this is helping to reduce the amount that would go into stock. Special qualities are not in much demand at the present time. There is, no doubt, better business ahead, but the movement towards more activity is slow.

Iron Ore.

The iron ore trade is poor, and as a consequence of the stoppage at Ulverston of one furnace there will be a reduction in the amount brought up at the Roanhead Mines. Other mines are not much employed, and the important Hodbarrow Mines still remain idle. Foreign ore is in moderate demand, and is arriving in limited quantities. A cargo of Spanish ore arrived last week at Barrow.

Steel.

The steel trade is dull, and although several mills are engaged, there are not many orders held, and the future is uncertain. At Barrow the rail mill is employed, and there is a certain amount of business being done in the output from the merchant mill. There is no life in ship plates and boiler plates, and the trade in billets is at zero at present. The hoop works are fairly well employed, the American orders having helped in the activity.

Shipbuilding and Engineering.

Shipbuilding is slow, and when the two vessels now being completed at Barrow, the Australian Commonwealth liner Jervis Bay and the tanker Scottish Musician, are finished the docks will be practically empty. It is hoped that the negotiations with the engineers regarding reduction of wages will come out satisfactorily. When matters are down to a minimum basis as regards costs then there may be a turn for the better. There are no new orders spoken of at present.

SHEFFIELD.

(From our own Correspondent.)

Profits and Prospects.

INTEREST during the past week has centered not so much in trade conditions of the moment—which, as a matter of fact, have changed but very-little—but in the results of last year's operations at Vickers' River Don Works, as disclosed in the directors' report, which has just been issued. Vickers' interests are so diverse and their manufacturing resources so huge that the degree of activity or idleness there is always taken as a very good criterion of the state of Sheffield trade generally. It was with some surprise, therefore, that a profit of over £700,000—£200,000 more than the previous year—was found to have been made. Shareholders and workmen's delight at the increasing measure of prosperity for Sheffield industry that these figures were at first supposed to indicate was, on reflection, modified, when it was realised that in all probability a very considerable proportion of these "profits" has in fact been made possible by the prospect of a substantial contribution from the Government in settlement of the taxation and other matters arising out of war-time activity. At the same time, the results certainly compare very well with those achieved by other firms similarly circumstanced.

More Steel.

The revival in America has to a certain extent reacted in Sheffield, a number of useful orders having been placed with local firms which supply crucible steel. Some heavy shell orders are also being executed for the United States, and certain local firms have been making armour coverings for motor cars, steel helmets and other war material for a destination which has not been disclosed. The demand for steel billets is said to be greater than has been experienced for a long time past. Messrs. Steel, Peech and Tozer, the principal firm in the United Steel Company combination, and the largest makers of mild steel billets in the district, are said to be running their Rotherham plant practically on full time, and in a week or two their output will, it is said, be increased appreciably by the starting of some of the furnaces at Templeborough, the very extensive works between Sheffield and Rotherham erected during the war. Two or three of the furnaces have been lighted up this week and should soon be producing material ready for the market. There has also been a substantial recovery in the steel trade of North Lincolnshire. Several local firms have booked further orders from Russia for cross-cut saws and other small tools and agricultural implements and machine parts. While relatively this business—which, I understand, is arranged on a cash basis—is not large, it is particularly acceptable at a time when work is badly needed. Much more could be done with Russia if our firms were prepared to give credit, but the only condition on which they will consent to trade is "cash with document." Inquiries from Russia and Poland have been considerably more frequent and for a greater volume of material of late, but as has been indicated, local firms are very shy of incurring any considerable liabilities in those European markets under present conditions. Meantime, as regards the home market, local manufacturers are discussing with much interest the announced further reductions in railway charges, while an equally vital factor in the return to anything like normal trade conditions is a cheapening in fuel costs. Here, however, something like an impasse seems to have been reached, the colliery owners and miners both asserting that at present prices a subsistence is impossible for either of them. The owners say that while costs of production have more than doubled since 1914, they receive from the merchants or consumers only 50 per cent. above 1914 rates, apart from increased carting charges.

Rail and "Tube" Orders.

Although the railway companies have not yet placed any considerable orders, some useful instalments are coming along. Messrs. Clayton and Shuttleworth, the well-known Lincoln firm, have secured an order from the London and North-Western Railway for five large-sized "Clayton" water-tube boilers of curved tube drum type, complete with superheaters, economisers, mechanical stokers and chimneys. The five boilers, which are similar to those being supplied by the firm to the London County Council for its Greenwich power station, are required by the railway company for the Formby (Lancashire) power station, where important developments are being undertaken in connection with the extension of electrification schemes. A few days ago it was reported from the London Iron and Steel exchange that a million pounds worth of orders in connection with the extension and reconstruction of the London "Tube" railways had been placed in the Derbyshire district. Inquiry somewhat qualifies this piece of good news. The Staveley and Sheepbridge Coal and Iron Companies, which are well equipped for the execution of such orders for "Tube" segments, have, it is true, received a fairly satisfactory share of the work, but to nothing like the value suggested, the major portion having, it is said, gone to North of England firms.

Alloys and Scrap.

Pending improved conditions in the tool trade—which in turn awaits a more general recovery in engineering—there is very little demand for tool steel, and the ferro-alloy market is consequently very dull. With the starting up of additional furnaces, however, to meet the growing demand for other steels, scrap is again being sought and commanding rather better prices. Dealers are, however, somewhat shy of making very heavy commitments in this connection, for a few of their number who had been tempted by the war-time boom—when steel makers paid any price that was asked for anything that could be described as scrap—have since paid the penalty of their rash enterprises.

Electricity Profits.

Sheffield Corporation Electricity Supply Department is able to make a contribution towards the rates of over £44,000 from its profits during the past year. The Water Department, on the other hand, is having to seek authority to increase its charges by 10 per cent. in order to avoid a deficiency.

University and Wireless.

Sheffield University—which has recently added wireless telegraphy and telephony to the subjects for examination in the Engineering Faculty—has installed an up-to-date station at which messages are received from as far away as Moscow and transmitted up to about 100 miles. Dr. Ripper, the head of the Applied Science Department, indicated further developments when he delivered a "wireless" lecture the other day to students of a college at Matlock, a couple of dozen miles distant on the other side of the Derbyshire moors. This lecture was given to inaugurate an interesting experiment by which it is proposed that the advantages of lectures by University professors can, in this way, be brought to the pupils at colleges distantly situated. Dr. Ripper expressed regret that in this country we are still a long way behind America in wireless developments, but stated that Sheffield University was prepared to do all in its power to remove this reproach. The experiment proved in every way successful.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trade Slowly Recovering.

ALTHOUGH a somewhat better feeling has been noticeable in commercial circles this week, it must be admitted that if a revival has at length really commenced progress towards restoration of normal conditions is indeed slow. The expectations of a considerable broadening out of demand in the iron and steel trades, consequent upon the re-starting of engineering establishments and foundries, have certainly not materialised. As a matter of fact, orders are chiefly confined to covering immediate requirements, and the total volume is not large. As a result there is a disposition on the part of manufacturers to pursue a cautious policy in the direction of increasing the output. Still, it is gratifying to record that idle plant is gradually being re-started, and that there is more confidence in the future outlook is reflected in the resumption of operations at two or three ironstone mines in the Cleveland district. There is, however, a great deal of headway to be made before labour, both in the steel and iron trades and the mining industry, can be fully absorbed. Unemployment on the North-East Coast is still deplorably high, and local authorities view with misgivings the probable state of affairs in the coming winter months. There is a streak of hope on the industrial horizon, it is true, but the question naturally arises, Can trade recover quickly enough to provide work for the thousands of unemployed? The problem is being earnestly tackled in all districts, and plans made accordingly. Their task is no easy one, when the state of two big and vital industries is considered. Take the position of the Cleveland miners. Out of a membership of 9000 in the Cleveland Miners' Association, some 7000 are idle; while iron and steel workers find themselves in an equally serious plight. In normal times there were seventy furnaces in operation on the North-East Coast; now there are only twenty-eight, of which seven are producing Cleveland foundry iron, eleven hematite, and ten basic iron. These facts alone prove that the process of restoration will be slow, unless, of course, there is a sudden boom, and there are no signs as yet of this. Employers are hopeful that the next few months will bring about a welcome change, and are proceeding steadily with their arrangements.

Plight of Iron and Steel Industry.

The disastrous plight in which the iron and steel industry finds itself is indicated by the figures issued by the National Federation of Iron and Steel Manufacturers, and the statement is of particular importance to the North-East Coast. Unemployment figures are distressing, as in May last only 70,723 men were at work, compared with 165,578 in June, 1920. Moreover, wages show a considerable reduction, having fallen to an average of £2 15s. 5d. per week per man. There is, however, one redeeming feature. Production appears to be on the upgrade, and signs are not wanting of a much-needed improvement in the outlook generally. The production on the North-East Coast during May was 130,600 tons of pig iron and 64,100 tons of steel, being a welcome improvement on the preceding month. Compared with the United States and France, the position of Great Britain in the production of iron and steel is a most unfavourable one. Productively, our Allies are forging ahead of us at an alarming rate. France, with fewer furnaces in blast, is getting infinitely better pig iron productive results than ourselves. The position thus created needs the careful consideration of both manufacturers and employees.

Cleveland Iron "Free."

The most important event of the week in the Cleveland iron trade is the announcement of the Ironmasters' Committee declaring a free market in Cleveland pig iron. The intimation is received with general satisfaction, both by sellers and buyers, for it leaves them with a free hand in bargaining. The agreement no doubt served its purpose, but of late there has been a feeling that the voluntary agreement should be abolished; and it is felt that the Ironmasters' Committee has done the right thing. Fixed prices first came in operation in February, 1916, when the home price of No. 3 Cleveland G.M.B. was officially recognised at 82s. 6d. When the Government subsidy was given, the home price advanced to 95s. 2d., and later when the subsidy was withdrawn, the makers controlled the price by a voluntary agreement. Since January last the ruling figure has been 90s. per ton, though it is interesting to recall that the highest point ever reached was 225s. per ton. At present it is difficult to anticipate what will be the result of again freeing the market, but it is expected there will be some modifications on what has hitherto been regarded as the official price. At the outset there will be no drastic price-cutting, though some con-

cessions may be made in home trade. Export prices will probably remain unchanged. Everyone is now awaiting developments following the Committee's decision, and business is consequently very restricted. The prices ruling at present are:—No. 1 and siliceous iron, 95s.; No. 3 Cleveland G.M.B., 90s.; No. 4 foundry, 87s. 6d.; No. 4 forge, 85s.; and mottled and white, 80s.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade has eased considerably during the week. Germany and South Wales are still taking fairly large quantities, but the demand from other quarters has fallen to a low ebb. Thus the stocks are steadily accumulating at a moment when makers are anxious to avoid any surplus, and one firm this week transferred a blast-furnace from hematite to Cleveland foundry iron production. Competition for orders is very keen, and there has been a good deal of price cutting. The quotation for mixed numbers (home) is 94s., and for export 93s. No. 1 quality is quoted at 95s.

Iron-making Materials.

Foreign ore trade is at a low ebb, and prices continue to fall. Best Rubio ore can be obtained at 25s. per ton, c.i.f., but it is not attracting buyers. Coke is firm, and nothing less than 27s. per ton delivered at the works is accepted.

Manufactured Iron and Steel.

Although more inquiries are moving in the manufactured iron and steel trade, there is no appreciable increase in the volume of business passing. Home trade is very quiet indeed, and there is little foreign work of importance on hand. Prices are being severely cut in order to attract export business. Steel plates are offered at as low as £9, and steel joists are reduced to £8 10s. being 30s. less than the quoted price for the home market.

5 Per Cent. Instead of 15.

Cleveland miners have accepted a wage reduction of 5 per cent. The mineowners claimed a 15.1 per cent. reduction, as compared with the previous quarter, and based it upon the usual formula in settling wages, the ascertained selling price of pig iron having been returned at 87s. 11.4d. per ton for the past quarter. The employers also claimed that the decrease in the rates of pay three months ago was less than the selling price figure would have given. The ultimate result of the joint conference was that a 5 per cent. reduction was agreed upon.

Blast-furnacemen's Wages Reduced.

A further reduction in the wages of blast-furnacemen employed on the North-East Coast has followed upon the issue of the quarterly ascertainment by the Cleveland Ironmasters' Association. The average net selling price of No. 3 Cleveland pig iron for the quarter ended June 30th was certified at 87s. 11.64d. per ton, a drop of 6.36d. per ton as compared with the realised price for the preceding quarter. In accordance with the sliding scale arrangement there will be an immediate reduction of 8.25 per cent. in the wages of blast-furnacemen, which will lower them to 26.25 per cent. above the standard.

The Coal Trade.

Business in the Northern coal trade is steadier and brighter than it has been for some time past, but there are difficulties to face, especially in regard to the state of the foreign exchanges. There is certainly some concern as to the effect of the remarkable slump of the German mark, which makes the price of British coal a startling figure when it arrives in Germany. So far, however, there is no confirmation of orders being cancelled, though, of course, forward contracting is at a standstill, and the general stability of the export market is slightly upset. Still, there are some redeeming features. The Christiania Gasworks have bought 40,000 tons of best Durham coals, to be shipped over in a period of a few months, at a price of 25s. 5d. per ton f.o.b., while the Finland Railway and Admiralty have purchased 13,000 to 14,000 tons of best screened steams from a Newcastle firm of exporters at current prices, the brands selected being best Scotch steams and D.C.B.'s, with option of best South Yorkshires. Generally speaking, the tone is good for prompt, but for further ahead buyers are asking for discounts on current quotations. Producers are still having to contend with Labour troubles, and a wages dispute at South Shields has caused a cessation of work by fully 10,000 men. It is not likely, however, that the trouble will spread. The demand for all classes of coal continues satisfactory. The position in Durham is gradually improving. It is understood that the South Metropolitan Gas Company has contracted for about half a million tons of Durham gas coals for delivery over the next nine months, based on current quotations, but with a fluctuating margin by which each month's price will be regulated by the then open market values. The Northumberland steam coal business maintains its general steadiness and activity. There is a shortage of best Blyth and best Tyne smalls, making the position all round very firm. Coking coals of the poorer classes and bunkers are slightly dragging, orders being short. Coke, on the other hand, maintains a steady tone for foundry and furnace.

SCOTLAND.

(From our own Correspondent.)

Dull Markets

THE longed-for improvement in trade is not yet apparent, and with the approach of the annual Fair holidays, the general state of things is quieter than ever. Some shipyards and other establishments are already closed, and there is a probability of a longer vacation than usual. Despite all efforts to stimulate business, orders are as scarce as ever. There seems no stability with regard to prices, and though in some instances buyers could almost name their own figures there is no apparent inclination to arrange contracts, as small lots can be picked up as wanted with practically the same price concession as for wholesale orders. Consequently, the works are being kept on starvation rations and employment is precarious.

The Outlook.

Many are hopeful that the early autumn will see a brightening up in most, if not all, branches of industry. Shipbuilding orders are rumoured, and also a large increase in export coal orders. Pig iron makers have increased the output a little in hopes of better things, though it must be said that so far their efforts have met with scant reward. The possibility of further reductions in railway charges is a heartening suggestion. If the shipbuilding orders materialise and the export coal trade makes an all-round improvement, general conditions in Scottish industry will soon assume a cheerful complexion.

Pig Iron.

The past week has seen a curtailment in home buying, especially of foundry qualities. Fair export orders are still going through, however. The demand for hematite continues on very restricted lines. Offers from America still arrive, but the prices named are not considered remunerative. Makers, however, are said to have enough orders to carry them over the holidays. Prices are firm. Buyers were again conspicuous by their absence from the last weekly meeting of the Glasgow pig iron ring, when sellers were quoted No. 3 G.M.B. Scotch at 99s., f.a.s. Glasgow; No. 3 G.M.B. Cleveland, 90s., f.o.b. Middlesbrough; and mixed numbers East Coast hematite, 95s., f.o.b. Middlesbrough.

Steel and Iron.

With few exceptions, the steel works are only existing from day to day. Contracting for forward delivery is almost unknown at present. Specifications are scarcer than ever for sectional material at present. Steel sheets are comparatively quiet, but more hopeful. The home demand is off, but the inquiry for both black and galvanised varieties on export account is improving. Bar iron makers have received little, if any, immediate benefit from the recent cut in prices, though extra orders may come through after the holidays. The steel departments of the bar iron industry are quieter, and prices are firm in spite of the reported importation of cheaper continental billets. The engineering trade is busier. The demand for scrap material has dropped off, due in a measure to the time of the year. Quotations remain firm, and there seems little likelihood of a reduction.

Depression in Coal Trade.

The lack of demand for round coal is a most depressing feature of the Scotch coal trade. Industrial and household fuels are selling poorly, and other consumers are only taking immediate requirements. The collieries are stocked out with large coal, and employment is sadly interfered with. The only bright spot in the meantime is the continued demand for washed nuts. Unfortunately, owing to the scarcity of orders for round coal, washed nuts are in poor supply. All available quantities are taken up and delays in transport are unavoidable. Many steamers are awaiting loading turns at both Leith and Methil. This scarcity has caused a further hardening in prices. Many are withholding quotations in the meantime, and prices mentioned are merely approximate. Prices for round coal still soften, and cheap lots are easily negotiated. Aggregate shipments for the week amounted to 280,016 tons, against 279,845 tons in the preceding week, and 325,595 tons in the same week in 1913.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

PROSPECTS of the coal export trade improving during the next few months are far from bright, and the position at the moment is disquieting. The foreign exchanges are worse than ever, and that is having a very bad effect upon business, which has been difficult enough during the past month or so. Consumers are deferring all but their most pressing requirements. The majority of the collieries are working short time, and the docks are what is known as "easy," which, in other words, means that there is not sufficient work to keep the appliances and the workmen fully engaged. Colliery salesmen are on the look-out for spot orders to enable them to get the release of wagons, and so keep their pits going, but it is a discouraging task, and the reduction of prices does not have a satisfactory influence upon the attraction of business. Reports from abroad show that stocks there of coal are being disposed of at less than cost price, while here at home the position is that collieries are getting down to rock-bottom, and the process of laying up tonnage because of the unremunerative character of rates of freight is continuing. Exporters who want to secure orders from abroad are almost compelled further to discount present prices of coal and current rates of freights; but it is a dangerous procedure, as, despite the lack of orders and the apparent easiness in the freight market, it is becoming daily more apparent that tonnage is becoming scarcer, and that owners will not run their steamers for the sake of running them. They cannot afford to do so. As for the collieries, it is doubtful whether there is enough business about to keep them going on an average four days a week.

Coal v. Oil.

It is something to the good when one finds that some of the miners' leaders are beginning to realise that the present position of the mining industry in this country is due not to local conditions, but to world-wide causes. At the same time, it is somewhat late in the day for the secretary of the Miners' Federation to complain about the competition of oil. This was pointed out over and over again at the time when the miners were top dog, and were forcing up costs of production and restricting output. The effect is now coming home to them. As stated by the secretary of the South Wales Coalowners' Association, it was only natural that consumers should seek other fuels, and how great has been the expansion of the use of oil fuel at sea may be gathered from the fact that whereas in 1914 only 364 sea-going vessels burnt oil, in 1920 the number had increased to 2336, and to-day oil-burning tonnage comprises nearly one-quarter of the world's shipping The British Admiralty alone has reduced its requirements by about a million tons of coal per annum, which is equivalent to 2 per cent. of the whole output of the South Wales coalfield. The future of the country depends upon its capacity to supply coal at a price that will make it preferable relatively to oil. How the f.o.b. price of coal has increased is shown in the following table of f.o.b. prices at South Wales and other British coal-exporting centres:—

Districts.	Quarter ending: March, 1914.	May, 1922.	Increase.
North-Eastern ...	12s. 7d. ...	21s. 10d. ...	9s. 3d.
Scotland	12s. 4d. ...	19s. 9d. ...	7s. 5d.
South Wales ...	15s. 5d. ...	25s. 0d. ...	9s. 7d.

Miners' Notices.

Following upon a special meeting of the Conciliation Board for South Wales coal trade, held on Monday, came the announcement that the miners' leaders have decided to recommend the workmen to defer the tendering of notices on the 17th inst., as had previously been decided upon. This announcement has not caused a great deal of surprise, as the folly of making the conditions in the industry worse than they are already by strike action must have been apparent to the leaders. In fact, the mere threat of a strike has had a sensible effect upon trade, as the men have discovered by the increased irregularity of employment. Although the leaders recommend the postponement of the notices, this is taken to mean in reality a withdrawal of the whole idea. The miners recognise the weakness of their position, and when their representatives on the Board addressed the owners, they appealed to the latter to assist them in restoring the Federation to its previous position. The chairman of the owners' side explained that they had no desire in any way to weaken, much less to break, the Federation, as they recognised that there must be some organisation on the part of the workmen with which negotiations could take place, and as far as they were concerned from that point of view they preferred dealing with a strong organisation rather than a weak one. It was not, however, the function of the owners to recruit or help to recruit members of the Federation, and it was made quite clear that there was no possibility of the Association deciding it could take part in either bringing pressure upon or coercing men to join the Federation, neither could the owners be parties to the workmen's representatives taking action at the collieries which would result in any workman not being able to carry out his contract of service or which would interfere with the working of the collieries. However, the owners on the Conciliation Board promised to call a meeting of the Coalowners' Association to discuss the whole situation, and a further meeting of the Conciliation Board will be held later. Meanwhile, the cases of alleged victimisation in the coalfield are to be dealt with by the Disputes Committee, so that altogether, from the labour point of view, the outlook is a little better. At the same time, miners' leaders are insisting that something has got to be done to enable the miners to make a decent living. They contend that either wages have to go up or the cost of living has to come down.

Tin-plate Order.

The report is current that a large contract of several thousand boxes has been secured by Welsh tin-plate makers from the Burma Oil Company. Messrs. Richard Thomas and Co., one of the largest manufacturers in this district, do not either confirm or deny the report.

Current Business.

Business for prompt shipment has been extremely quiet during the past week, and next to nothing is being done so far as forward operations are concerned. The tone of the steam coal section is easy, but many collieries have reached their limit, and if they cannot get the prices they are now naming, they are stopping their collieries. Nominally best Admiralty large are quoted at 24s. 6d. to 25s., but in exceptional cases for spot shipment, sales have been effected as low as 24s. The reduced output of large coals, owing to curtailed working of pits, has meant that small coals are not so plentiful, and consequently the market for these is relatively steadier. As regards the anthracite section, best large coals are about steady, but other grades of large only just about hold their own. Sized coals are, however, very scarce and firm, and cobbles are almost unobtainable at 62s. 6d. to 65s., business at the latter figure having been done. Duff and rubbly culm are on the quiet side.

PRESENTATION TO MR. HENRY J. SPOONER.—The presentation of a testimonial to Mr. Henry J. Spooner, on the occasion of his retirement from the Headship of the Polytechnic School of Engineering, which post he has occupied for the past forty years, will take place at the Polytechnic on Wednesday, July 19th, at 4.30 o'clock. All subscribers to the testimonial fund are invited to be present.

A CENTURY OF PROGRESS.—We have received from the Horseley Bridge and Engineering Company, of Tipton, Staffs., an illustrated brochure which gives a brief outline of the history of that firm during the past hundred years. The name is, of course, familiar to engineers of the present generation in connection with bridges and other structural steel work, so it may come as a surprise to learn that the early activities of the Horseley Company included shipbuilding, the first iron steamer the Aaron Manby, having been built at Tipton, besides several others. She was built in 1822, but the records of the company go back as far as 1770. The situation of the works was naturally not suitable for shipbuilding, and later the firm reverted to structural work, which it has carried out all over the world. During the war, however, the works again had some experience of shipbuilding, as they turned out a quantity of steel work for standard fabricated ships.

Current Prices for Metals and Fuels.

IRON ORE.

N W. COAST—	
Native	25/-
(1) Spanish	25/-
(1) N. African	25/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	25/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 8 9	—
No. 1 Foundry	5 0 0	—
No. 3 Foundry	15 0	—
N.E. COAST—		
Hematite Mixed Nos.	4 13 0	4 13 0
No. 1	4 14 0	4 13 0
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 7 6	4 7 6
No. 4 Forge	4 5 0	4 5 0
Mottled	4 0 0	4 0 0
White	4 0 0	4 0 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
Part Mine Forge	*None offering.*	
North Staffs. No. 3 F'dry	4 5 0 to 4 10 0	
(3) Northampton—		
Foundry Nos. 2 and 1	*Nominal.*	
,, No. 3	4 0 0	—
,, Forge	3 10 0 to 3 12 6	
(3) Derbyshire—		
No. 3 Foundry	4 0 0 to 4 2 6	
Forge	3 12 6 to 3 15 0	
(3) Lincolnshire—		
Basic	4 0 0 to 4 5 0	
Foundry	4 5 0 to 4 10 0	
Forge	4 2 6 to 4 5 0	
(4) N.W. COAST—		
N. Lancs. and Cum.		
Hematite Mixed Nos.	5 15 0	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 10 0	10 10 0
Best ,,	12 0 0	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	10 10 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	13 15 0
S. YORKS.—		
Crown Bars	12 0 0	—
Best ,,	13 0 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	11 0 0	—
Marked Bars (Staffs)	13 10 0	—
Nut and Bolts Bars	10 0 0	—
Gas Tube Strip	11 0 0 to 11 5 0	
Hoops (Nom.)	14 0 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates ⅜in. and up	10 0 0	—
Sections	9 10 0	—
Steel Sheets ⅝in. to ¼in.	11 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	15 10 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 0 0	9 0 0
Angles	9 10 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	8 10 0
Heavy Rails	9 10 0	—
Fish-plates	14 10 0	—
Channels	14 10 0	—
Hard Billets	8 15 0	—
Soft Billets	7 15 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 10 0	—
Light ,,	11 0 0 to 13 0 0	
Billets	9 5 0	—
Ship Plates	10 0 0	—
Boiler ,,	13 10 0	—
MANCHESTER—		
Bars (Round)	9 10 0 to 11 10 0	
,, (others)	10 10 0 to 11 10 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	12 5 0	12 0 0
Plates	9 10 0 to 11 0 0	
,, (Lancs. Boiler)	15 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	12 10 0	—
Hard Basic	8 15 0	—
Soft ,,	7 10 0 to 7 15 0	
Hoops	12 5 0	—
Soft Wire Rods	11 0 0	—
MIDLANDS—		
Small Rolled Bars	9 5 0 to 9 10 0	
Bessemer Billets	7 10 0	—
Hoops	11 10 0 to 12 0 0	
Gas Tube Strip	10 5 0 to 10 10 0	
Sheets (24 W.G.)	12 10 0	—
Galv. Sheets (f.o.b. L'pool)	16 0 0	—
Angles	9 10 0	—
Joists	10 0 0	—
Tees	10 10 0	—
Bridge and Tank Plates	10 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/6 to 19/9
Block Tin (cash)	153 10 0
,, (three months)	154 5 0
Copper (cash)	62 18 9
,, (three months)	63 7 6
Spanish Lead (cash)	24 5 6
,, (three months)	23 5 0
Spelter (cash)	28 6 3
,, (three months)	28 3 9
MANCHESTER—	
Copper, Best Selected Ingots	68 10 0
,, Electrolytic	70 10 0
,, Strong Sheets	94 0 0
,, Loco Tubes	0 1 1½
Brass Loco Tubes	0 0 11¾
,, Condenser	0 1 2¾
Lead, English	25 15 0
,, Foreign	24 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£27	10/-
,, 6 p.c. to 8 p.c. ,,	£25 10 0	9/-
,, 8 p.c. to 10 p.c. ,,	£24 10 0	8/-
,, Specially Refined		
Max. 2 p.c. carbon	£65	26/-
,, 1 p.c. ,,	£80	30/-
,, 0·75 p.c. carbon	£85	37/-
,, carbon free	1/1 per lb.	
Metallic Chromium	5/3 per lb.	
Ferro Manganese (per ton)	£15 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£13 0 0 scale unit	5/- per
,, ,, 75 p.c.	24 10 0 scale unit	6/- per
,, Vanadium	18/- per lb.	
,, Molybdenum	6/6 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£160	
Cobalt	11/- per lb.	
Aluminium (per ton)	£110 to £120 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	17/-
,, ,, Ell	17/6
,, ,, Splint	18/6 to 21/-
,, ,, Trebles	20/-
,, ,, Doubles	19/-
,, ,, Singles	18/3
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/-
,, ,, Splint	19/-
,, ,, Trebles	20/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	17/6 to 21/-
Screened Navigation	26/-
Trebles	20/-
Doubles	19/3
Singles	18/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	18/6
Secondary Steam	17/9
Trebles	20/6
Doubles	19/3
Singles	18/6

ENGLAND.

(8) N.W. COAST—	
Steams	33/-
Household	40/- to 61/-
Coke	34/-
NORTHUMBERLAND—	
Best Steams	23/- to 24/-
Second Steams	22/6 to 21/6
Steam Smalls	15/- to 17/-
Unscreened	20/6
Household	25/- to 28/-
DURHAM—	
Best Gas	21/6 to 22/-
Second	19/- to 20/6
Household	25/- to 28/-
Foundry Coke	30/- to 35/-

SHEFFIELD—	INLAND.	
S. Yorks. Best Steam Hards	21/- to 22/-	—
Derbyshire Hards	20/- to 21/-	—
Seconds	18/- to 20/-	—
Cobbles	17/- to 19/-	—
Nuts	16/- to 18/-	—
Washed Smalls	1 /- to 11/-	—
Best Hard Slacks	12/- to 13/-	—
Seconds ,,	9/- to 10/6	—
Soft Nutty ,,	7/6 to 8/6	—
Pea ,,	7/- to 8/-	—
Small ,,	2/- to 4/6	—
House, Branch	30/- to 33/-	—
,, Best Silkstone	27/6 to 29/-	—
Blast Furnace Coke (Inland and Export)	19/- to 21/-	

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	24/6 to 25/-
Second ,, ,,	24/- to 24,6
Best Dry Large	24/6 to 25/-
Ordinary Dry Large	23/- to 24/-
Best Black Vein Large	24/- to 24/6
Western Valley ,,	24/- to 24/6
Best Eastern Valley Large	24/- to 24/6
Ordinary ,, ,,	22/- to 23/-
Best Steam Smalls	18/- to 18/6
Ordinary ,,	15/- to 17/-
Washed Nuts	22/6 to 24/-
No. 3 Rhondda Large	26/- to 27/-
,, ,, Smalls	18/- to 19/-
No. 2 ,, Large	22/- to 22/6
,, ,, Through	18/6 to 19/6
,, ,, Smalls	14/- to 15/-
Coke (export)	35/- to 37/-
Patent Fuel	24/6 to 27/-
Pitwood (ex ship)	31/6 to 32/-
SWANSEA—	
Anthracite Coals:	
Best Large	50/- to 52/6
Seconds	40/- to 42/6
Red Vein	29/- to 30/-
Big Vein	42/6 to 47/6
Machine-made Cobbles	62/6 to 65/-
Nuts	60/- to 62/6
Beans	37/6 to 40/-
Peas	23/- to 25/-
Breaker Duff	8/- to 8/6
Rubbly Culm	15/- to 15,6
Steam Coals:	
Large	21/- to 23/-
Seconds	20/- to 21/-
Smalls	14/- to 15/-
Cargo Through	18/- to 20/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b for export. (9) Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Trade Crisis.

THE rapid decline in the value of the franc this week, following upon the collapse of the German mark, is taken here as showing that there can be no stability and therefore no trade recovery until the question of reparations has been settled one way or another. Every improvement in the exchange rate has helped to revive confidence and bring about a little more trade activity in the belief that things were taking a turn for the better, and every set-back in the value of the franc has destroyed the confidence and made the situation appear to be worse than it was before. The results cannot be otherwise, for the whole future depends upon the amount of money that can be spent on public works, and as the State has embarked upon a commendable policy of economy in the hope of placing national finance on a firmer basis there are very few orders being given out to the engineering and other industries. Nor can anything be done until there is some definite understanding over the question of reparations. It is evident that so long as the State finds its hands tied by labour opposition and financial difficulties no immediate help can be afforded to the industry, and therefore the country has favourably received the scheme presented by M. Le Trocquer for employing German aid in the execution of the programme of public works.

The Reparation Scheme.

The proposals of the Minister of Public Works have been approved by the Cabinet, and are now being submitted to the Reparations Commission. They provide for the carrying out of works representing a total cost of 4827 million francs, to which the German contribution in men, material and machinery will be 3897 million francs. French firms will supply a large proportion of the hydraulic and electrical equipment. For the Rhone the value of the machinery and plant to be furnished by the Germans will be 550 million francs and by the French 150 million francs. For the De la Truyère and Dordogne hydraulic schemes France will supply all the engineering equipment. In the case of the canals connecting up the Saar with the Moselle and Meuse and the Meuse with the Schelde the French will supply about one-half the total equipment for electric traction. Difficulties have already arisen over the question of the import duties on the German material and machinery to be used in the carrying out of the work, and it is probable that the negotiations with the Germans will not proceed so smoothly as the French anticipate; but if the Reparation Commission can impose the scheme on Germany a good deal of employment will be provided for the engineering trades for some years to come.

New Industries.

After the Armistice all sorts of new industries were introduced into the country with a view of providing employment for the factories which were being turned on to peace work, and the nursing of those industries was the cause of the somewhat erratic fiscal policy that has been adopted since then. It is now perceived that there is little to be gained by creating new industries if the goods cannot be produced at a cost that will allow of their being offered at a saleable price. The productive cost has, in fact, been increasing with a diminishing demand, and several firms which found that they were sustaining heavy losses, have been obliged to give up the manufacture of competitive goods. Thus, one of the biggest concerns in the neighbourhood of Paris has had to close the shops in which it has been manufacturing textile machinery, hot bulb engines and sewing machines. Most of the makers of hot bulb engines are faring badly on account of the dearth of work in shipyards. The Société des Moteurs Gnome et Rhône has abandoned nearly all its new manufactures, and is giving attention more particularly to the Jupiter aviation engine, which it is building under license. Nearly all the aeroplane builders who thought it prudent to embark upon new branches of manufacture are now returning to the construction of aeroplanes and hydroplanes, for which orders have been given out by the Government.

Rolling Stock.

The operations of the Société Auxiliaire de Matériel de Chemins de Fer, which was formed some time ago by Lorraine-Dietrich, Cail, le Matériel Roulant, and other concerns with a view of securing orders for rolling stock in Poland, Roumania and other countries in Eastern Europe have been causing some uneasiness amongst other wagon builders, who suspected that the Société Auxiliaire was under the patronage of the State. It is now officially denied that the State has anything to do with the company which, it appears, is trying to dispose of the 20-ton surrendered German wagons for which no use can be found in France. The company expects to find a market for them in Poland, Roumania, and even in Russia. It is hoped that the disposal of the surrendered German wagons will allow of French firms securing orders for new rolling stock, but seeing that the prices tendered recently by French builders have been about double those of the Germans it does not appear as if prospects are encouraging.

The Basset Steel Process.

Whatever may be the future of the Basset direct process of steel making, it is clear that a large number of shareholders in the company are not satisfied with the complete absence of practical results. M. Basset admits that there have been technical difficulties, which, he says, are all being overcome. There has been trouble with the linings of the rotary furnaces which were unable to stand the extremely high temperatures necessary for the success of this process. M. Basset also confessed at the general meeting that he is at present unable to produce steel to specification. This, he said, depends solely upon the furnace. Although big works have been equipped for the production of Basset steel the process has not yet entered the industrial phase, but, said M. Basset, they were very near it, and the time was not far distant when they would be producing steel at one-half the present cost and exporting it to England.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

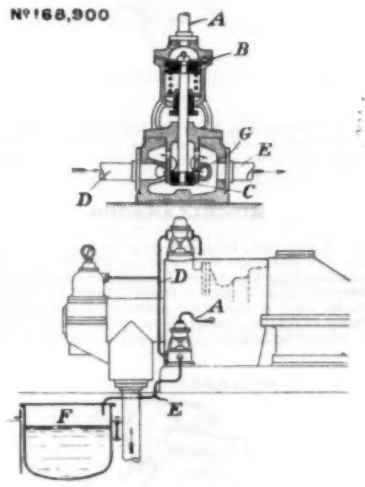
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM TURBINES.

168,900. September 5th, 1921.—APPARATUS FOR LIMITING THE POWER OUTPUT OF STEAM OR GAS STATIONS, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

A pipe A leading from the interior of the turbine terminates above a piston B fitted with a return spring, which can be so adjusted as to determine the pressure at which the piston moves. Fixed to the piston-rod is a sliding member C, which acts upon oil under pressure in the pipe D, the oil actuating the controlling mechanism. The pipe E serves to return the oil to the tank F. When the pressure in the interior of the turbine, for instance in the wheel casing of the high-pressure wheel, rises beyond a determined limit, the piston B, in compressing the

Nº168,900



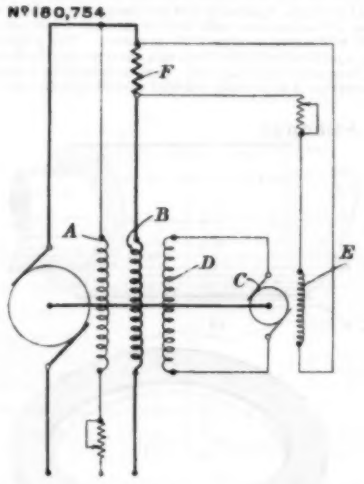
spring, moves the sliding member C downwards. The aperture G is then uncovered so that pressure oil can flow from the distributing system through the pipe D, and, owing to the diminishing pressure of the distributing oil, the steam inlet valve of the turbine is closed until the steam pressure existing in the interior of the turbine and acting upon the piston B has dropped to a determined maximum limit. In this manner a determined maximum pressure in the turbine, capable of adjustment by means of the spring, cannot be exceeded. The control apparatus may, however, be set to any other desired smaller pressure limit by a correspondingly smaller stressing of the spring.—*June 8th*, 1922.

DYNAMOS AND MOTORS.

180,754. March 1st, 1921.—IMPROVEMENTS RELATING TO DIRECT-CURRENT ELECTRIC MOTORS, Reginald John Butter, of 60, Norwood-road, Stretford, Manchester, and the Metropolitan-Vickers Electrical Company, of 4, Central-buildings, Westminster.

The object of this invention is to provide an automatic regulating arrangement for a compound-wound motor which is required to run at a number of speeds and which is subjected to varying loads. A and B are the shunt and series windings. C is an exciter which excites a third winding D. The field winding E

Nº180,754



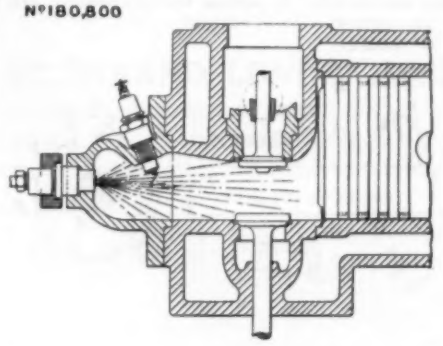
of this exciter is connected across a resistance F, so that the winding E is excited in proportion to the variations of the current in the series circuit of the motor. The field winding D opposes the series winding B and the regulation of the series winding B is varied by means of the exciter in such a manner that the effect is large at a low speed and is decreased automatically as the speed of the motor increases.—*June 1st*, 1922.

INTERNAL COMBUSTION ENGINES.

180,800. May 19th, 1921.—IMPROVEMENTS IN OIL ENGINES, Walter Nevill Scholes and Herbert Reed Hall, both of Victoria Works, Denton, Manchester.

THE essential feature of this invention is the employment of direct injection, without the use of compressed air, in combination with a low compression and electric ignition. The full charge is injected by a pump through an atomiser or spray

Nº180,800



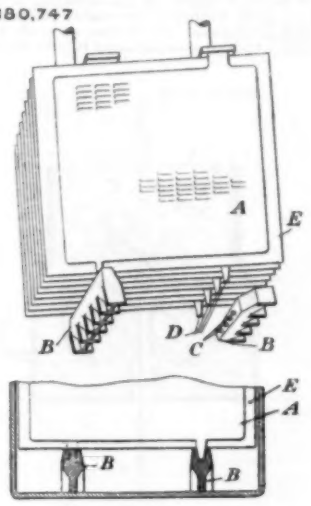
nozzle, which pulverises the fuel and makes it assume the form of a fine mist, the charge being projected on to a sparking plug supplied with electric current from a magneto machine or induction coil.—*June 8th*, 1922.

BATTERIES AND ACCUMULATORS.

180,747. February 28th, 1921.—IMPROVEMENTS IN ELECTRIC STORAGE BATTERIES, *The Chloride Electrical Storage Company, Limited, of Clifton Junction, near Manchester.*

Each group of plates A of the same polarity is supported by a non-conducting pedestal strip B, which may be made of rubber or other elastic material and have holes or sockets C into which

Nº180,747



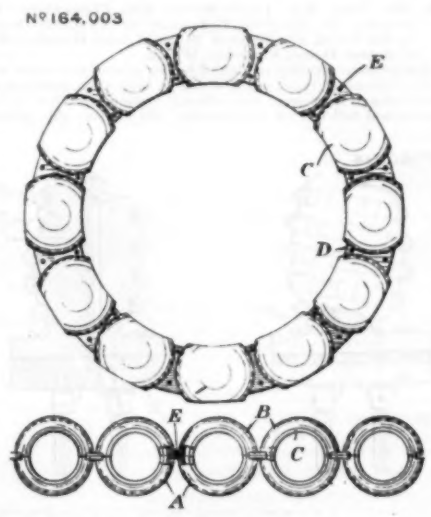
feet D project. The sides of the pedestal strips B may butt against the sides of the glass container and serve to cushion the plates against shocks. The separators E are made larger than the plates and they rest upon the strips B.—*May 29th*, 1922.

TRANSMISSION OF POWER.

164,003. May 30th, 1921.—CAGES FOR BALL BEARINGS, Maschinenfabrik "Rheinland" Actien-Gesellschaft, of 9/29, Zimmerstrasse, Dusseldorf, Germany.

The cage consists of two identical parts A B of sheet metal, each of which is provided with pockets C for the balls. After the balls have been introduced between the races (not shown) the two parts of the cage are pushed over the balls so that the

Nº164,003



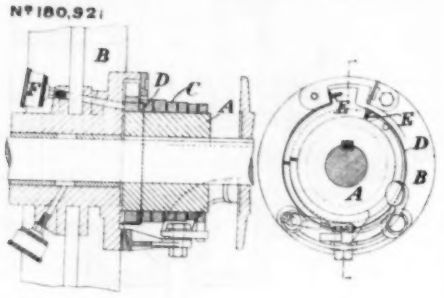
surfaces D between the pockets are caused to bear closely against each other, as is shown in the lower drawing. The two parts of the ball-bearing cage are then welded together by means of a point electric welding machine and preferably at about the points denoted by E.—*June 8th*, 1922.

180,921. June 30th, 1921.—IMPROVEMENTS RELATING TO THE LUBRICATION OF COIL CLUTCHES, The Coil Clutch Company, Limited, Phœnix Works, Johnstone, Scotland, and George Gordon Douglas, of the same address.

In order to reduce the work and attendance necessary for the

efficient lubrication of coil clutches it is proposed in accordance with this invention to provide means for retaining lubricant in contact with the coils. The clutch is of the ordinary coil type with driving and driven members A and B with a coil C interposed between them. In addition there is a retaining strip D

No 180,921



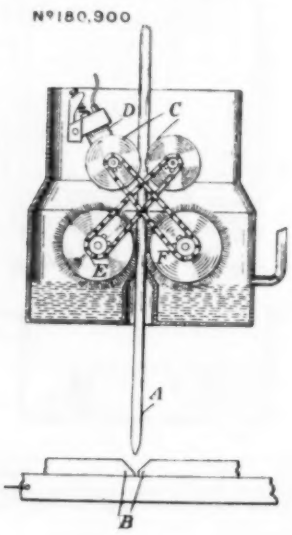
of sheet metal which is secured in place by screws E, the strip having a somewhat greater diameter than the turns of the coil which it encloses, so as to have an annular space, and is of sufficient width partly to overlap the next adjacent turn of the coil. A grease cup F on the driven member B communicates with the interior of the retaining strip D and grease works its way between the convolutions of the coil and between the latter and the driving member A.—*June 8th*, 1922.

ELECTRIC WELDING.

180,900. May 31st, 1921.—IMPROVEMENTS IN AND RELATING TO ELECTRIC ARC WELDING MACHINES, *The British Thomson-Houston Company*, 83, *Cannon-street, E.C.*

One of the chief objects of this invention is to enable flux-covered electrode welding to be readily performed with automatic welding machines. The welding electrode A is arranged to weld together the two pieces of metal B. The electrode is moved

No 180,900



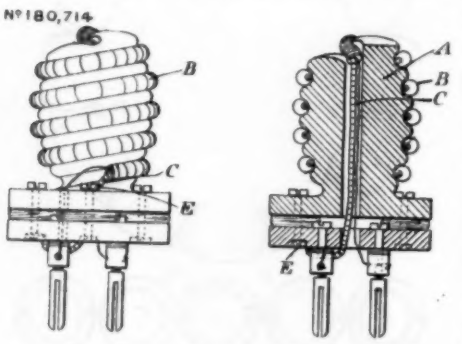
forward by two feeding rollers C, the current being fed into the electrode through a brush D. The coating material for the electrode is placed in the tank through which the electrode passes, and two rotary brushes E and F apply the coating material.—*June 8th*, 1922.

LIGHTING AND HEATING.

180,714. June 8th, 1922.—MEANS FOR PREVENTING THE SAGGING OF HEATING ELEMENTS OF ELECTRIC FIRES, James Young Fletcher and Reginald John Hamilton Hill, of Magnet House, Kingsway, W.C. 2.

The grooved fire-clay or similar holder A with resistance wire B is of the usual type, and it will be evident that, although the wire is placed in grooves, the coils will expand when hot and the wire would fall out of the grooves. To obviate this a bead-

No 180,714



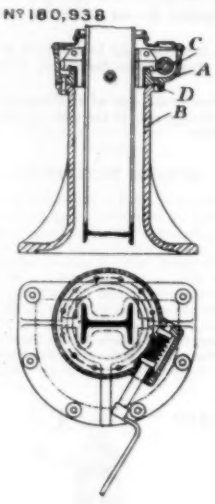
covered wire C is threaded through the coil and is fixed to screws E in the base of the holder. This wire is pulled sufficiently tightly securely to hold the resistance in the grooves and the beads effectively insulate the wire in them from the resistance.—*June 8th*, 1922.

SHIPS AND BOATS.

180,938. July 27th, 1921.—IMPROVEMENTS IN OR RELATING TO DAVITS, George Pate, O.B.E., and John Harley Mercer, both of the Carron Company, Carron, Falkirk.

The davit column is constructed so that the operating handle and the worm shaft can be set at any desired angle to the outboard line of the vessel on which the davit gear is fitted. The column is made in two parts A and B and the upper part or head A, which carries the worm gear C and the operating handle, is

No 180,938



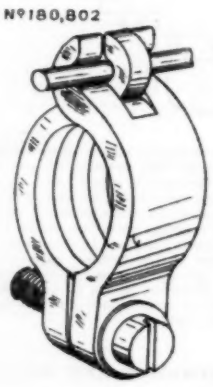
adapted to be bolted at D to the lower part in any one of a number of selected positions, whereby the operating handle and worm shaft may be set at the required angle.—*June 8th*, 1922.

MISCELLANEOUS.

180,802. March 21st, 1921.—A NEW OR IMPROVED EARTHING CLIP FOR ELECTRIC CONDUCTORS, The Walsall Hardware Manufacturing Company, Limited, of Hatherton Works, Ablewell-street, Walsall; Albert Edward Read, Jane Ellen Franks, both of the above address; and Charles Godfrey Maisey, of Addison Bridge, Kensington-road, London, W. 14.

This invention relates to an improved earthing clip which

No 180,802

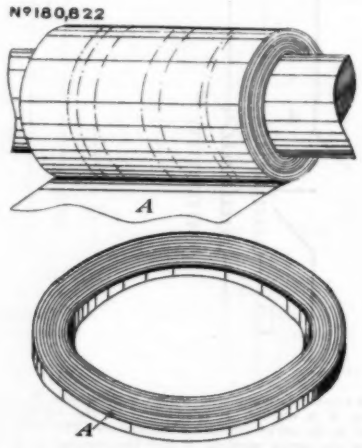


comprises a band of metal which is split or divided and two of the ends can be drawn together so as to make the band circumferentially contractible. It is also provided with projections upon its inner surface, enabling it to be tightened on to a conduit tube so that it will form a satisfactory electrical contact therewith.—*June 8th*, 1922.

180,822. March 31st, 1921.—IMPROVEMENTS IN JOINT-MAKING PACKING, Henry Connolly and Benjamin Lumsden Connolly, both of St. Stephen-street, Salford.

The object of this invention is to provide a packing or jointing material for steam, hydraulic and gas flange rings which will not vulcanise or disintegrate with heat or moisture, will not oxidise and will withstand a very high pressure. The joint-making packing is preferably in the form of a circular ring as shown, but may be hexagonal or octagonal. It is composed of a number of layers or strips A of textile material wound spirally or helically

No 180,822



on a mandrel. A suitable cotton, linen, silk or other cloth is thoroughly saturated or impregnated with an adhesive composition which will withstand heat and moisture without vulcanising or oxidising, and formed with a base of rubber mixed with an inert material such as powdered whitening, chalk, asbestos, kieselguhr, lead oxide, or zinc oxide in such proportions as will give an adhesive or sticky surface. The impregnated cloth is wound tightly on a mandrel into a compact mass and is afterwards cut by circular or other cutters into rings of the desired thickness.—*June 8th*, 1922.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TUESDAY TO FRIDAY, JULY 18TH TO 21ST.

HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND.—Ninety-first annual Show at Dumfries.

SATURDAY, JULY 22ND.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Southern District meeting at Basingstoke Town Hall. 10.30 a.m.

WEDNESDAY TO FRIDAY, SEPTEMBER 20TH TO 22ND.

THE INSTITUTE OF METALS.—Swansea. Annual autumn meeting.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

BRITISH INSULATED AND HELSBY CABLES, Limited, intimate that they have removed their London office from Lennox House to Surrey House, Embankment, W.C. 2.

MR. CHARLES ERITH, A.M.I. Mech. E.—trading as Charles Erith and Co.—has removed to Palace Chambers, Bridge-street, S.W. 1, London. Telephone, 6145 Victoria.

WE are informed that Mr. H. A. Mumford has been appointed district manager at Leeds for the Edison Swan Electric Company, Limited, succeeding Mr. J. D. Chisholm, resigned.

MESSRS. GEORGE F. WEST AND CO., Iddesleigh House, Westminster, announce that they have terminated their sales agency arrangements with the Widnes Foundry Company, Limited, Widnes.

WE are asked to state that Mr. W. D'Arcy Madden, M.I.E.E., general manager of Hick, Hargreaves and Co., Limited, of Bolton, has joined the Board of the Company and has been appointed managing director.

WALTER JUDD, Limited, informs us that, owing to the termination of its lease, it has transferred its offices from 97, Gresham-street to 81-87, Gresham-street, London, E.C. 2. The telephone number will remain the same, viz., London Wall 3651/2.

THE BALL BEARING SUPPLY CO., of 56 to 58, Eagle-street, Southampton-row, London, W.C. 1, informs us that it has been appointed sole British agent for the Italian firm of ball bearing manufacturers, Officine Di Villar Perosa, Villar Perosa, Pinerolo, Italy.

WE are asked to state that W. Warburton and Co., Limited Turbine Works, Halifax, England, have appointed the London Factors and Agents, Limited, of 38/39, Parliament-street, London, S.W. 1, their sole agents for London, the South of England and South Wales.

ALFRED HERBERT, Limited, of Coventry, informs us that it has been appointed sole selling agent in Canada for the mining machinery, air compressors, rock drills and pneumatic tools made by Messrs. Holman Bros., of Camborne, Cornwall, and sole selling agent in the Argentine for the horizontal surfacing, boring, milling and drilling machines made by Messrs. H. W. Kearns and Co., of Broadheath, Manchester.

LAUNCHES AND TRIAL TRIPS.

BRITISH GRENADIER, oil tank steamer; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the British Tanker Company, Limited, of London; dimensions, 455ft. by 57ft. beam; to carry over 10,000 tons of oil. Engines, Metropolitan-Vickers-Rateau type turbines with double reduction gearing; constructed by the builders; trial trip, July 4th; speed 11¾ knots fully laden.

DIOGENES, twin-screw passenger and cargo vessel; built by Harland and Wolff, Limited, to the order of Geo. Thompson and Co., Limited (Aberdeen Line), for the Australian service; dimensions, 500ft. by 63ft. by 35ft. 3in. deep; 12,300 gross tonnage. Engines, Brown-Curtis compound turbines with double reduction helical gearing; constructed by the builders; provision made for 132 first-class and 422 third-class passengers; trial trip, recently.

HITHERWOOD, steel screw steamship; built by J. Samuel White and Co., Limited, of East Cowes, to the order of Messrs. C. A. Stewart and Co., of London; dimensions, length overall, 266ft. 6in.; length between perpendiculars, 255ft.; breadth, moulded, 40ft.; depth, moulded, 18ft. 1in.; draught, 17ft.; to carry about 2500 tons deadweight. Engines, triple-expansion, 19in., 32in., and 52in. by 36in. stroke, pressure 180 lb.; constructed by the builders; launch, July 8th.

CONTRACTS.—Sir William Arrol and Co., Limited, have received orders for eight 5-ton overhead electric travellers; one 100-ton and one 15-ton overhead travellers; two portable steam power grabbing cranes for South America; a large coaling transporter for Australia, and a 25-ton special wharf crane and several steam excavators.—Clayton and Shuttleworth, Limited, Lincoln, have received an order from the London and North-Western Railway for five large-sized "Clayton" patented water-tube boilers of the curved tube drum type, complete with superheaters, economisers, mechanical stokers and chimneys for the Formby (Lancashire) power station.—The Imperial Government Railways of Japan has just placed with the English Electric Company for its Dick-Kerr Works at Preston an order for thirty-four complete electric locomotives of the total value of upwards of £500,000. This represents the whole requirement of locomotives up to the end of 1923 for those sections of the main line railways which the Japanese Government has decided to electrify at once. Eight of the locomotives now ordered are for heavy express passenger service. They are of the 2-C-C-2 type. Their weight is approximately 96 tons and they are designed to haul a 415-ton train at a balancing speed of about 60 miles per hour. Of the remaining locomotives, nine are for local passenger service and seventeen are for heavy goods service. They are all of the B-B. type and will weigh approximately 56 tons each.—In connection with its new electricity scheme the Douglas Corporation has ordered from Ruston and Hornsby, Limited, of Lincoln, two "Ruston" twin-cylinder cold starting oil engines of 340 brake horse-power.—The Underfeed Stoker Company, Limited, has recently received orders for nineteen travelling grate stokers, for three Class E stokers, and for five ash conveyors, the orders coming from seven electric power stations at home and abroad and from five collieries.—Automatic Electric Furnaces, Limited, of 281–283, Gray's Inn-road, London, W.C. 1, has recently received orders for its furnaces from six customers in Norway, three each from Holland and India, two from each France and Germany, and one each from Australia, Buenos Aires, Denmark, Japan, and Spain.